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DETERMINANTS OF STUDENT LEARNING SATISFACTION AND ACADEMIC PERFORMANCE IN HIGH SCHOOL CHEMISTRY: A PREDICTION MODEL BUILDING STUDY FOR ONLINE LEARNING

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Biographical Sketch

Melba C. Patacsil, born on August 6, 1968, in Dagupan City, is a remarkable individual who wears multiple hats with grace and determination. A devoted mother of three children, consisting of one girl and two boys, she cherishes her family above all else and believes that family is the ultimate gift a woman can have.

As a passionate educator, the researcher found her calling in Chemistry, a subject that sparked her curiosity and love early on. She is not only a teacher but also a mentor and role model to countless students. Her dedication to education led her to embark on a fulfilling career that spans several institutions.

As the second child of Mr. Isidoro Calaguin and Mrs. Rebecca Maneclang, the researcher assumed a significant responsibility when her father passed away. Being the first female in the family, she took it upon herself to support her siblings' education, ensuring they had the opportunity to attend school and pursue their dreams.

At the age of 20, she entered the field of teaching at the University of Pangasinan. It was here that she discovered her passion for guiding and molding young minds, finding immense joy and fulfillment in her profession. For 19 years, the researcher dedicated herself to the University of Pangasinan, leaving an indelible mark on the lives of her students.

Her thirst for growth and knowledge led her to seek new opportunities, and she eventually moved to the University of Cordilleras in Baguio City. Later on, she made another significant transition to the University of the Philippines (Baguio). During her tenure at UP Baguio, she discovered her passion for research, and her work in

Chemistry was published internationally, solidifying her reputation as a respected researcher in her field.

However, the researcher’s journey didn't end there. She had promised herself that she would retire as a high school teacher to inspire and enlighten the youth about the beauty of Chemistry. She fulfilled her promise by joining the Philippine Science High School, where she has been passionately teaching for 12 years now.

Throughout her career, the researcher’s pursuit of knowledge has known no boundaries. Her experienced as a PhD student at the University of the Philippines Open University (UPOU) broadened her perspective on education. She learned that a teacher's ultimate goal is to persevere in learning and embracing new ideas to enrich the lives of their students.

The COVID-19 pandemic brought about unprecedented challenges, pushing educators to adapt to online teaching. The researcher embraced this change with grace, drawing strength from the experiences she gained at UPOU. Despite the difficulties, she remained an advocate for change and an inspiration to her students, proving that education transcends physical boundaries.

The researcher is immensely grateful for the growth and transformation that UPOU brought into her life. Her dedication to teaching, her unwavering love for her family, and her passion for Chemistry have all contributed to her becoming a remarkable individual and a shining example to those around her.

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M.C.P.

Dedication

To my beloved family and my Almighty God:

Your unwavering support, encouragement, and love have been my guiding light throughout this journey. Your constant belief in me has helped me overcome every obstacle and push through every challenge. I am truly grateful for your presence in my life, and I cannot express my appreciation enough.

To my almighty God, who gave me strength and wisdom when I needed it most, thank you for being my rock and my fortress. Your love and grace sustained me through this journey, and I am forever grateful.

To my beloved family, I dedicate this dissertation to all of you, with all my heart. This accomplishment is not only mine, but it belongs to you as well. Thank you for being my motivation and my inspiration. Your love and support made this possible, and I am honored to have you in my life.

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ABSTRACT

Learning satisfaction is a key indicator to enriching student learning whether it is face-to-face or online mode of delivery. Learning has shifted more to remote online learning due to the Covid-19 pandemic. This study aimed to identify the determinants of Student Learning Satisfaction (SLS) in online learning and develop a model that represents the relationship of the determinants to SLS. The study explored both internal and external determinants hypothesized to influence SLS among 169 students in grades 9-12 taking Chemistry at the Philippine Science High School Cordillera Administrative Region Campus (PSHS CARC). The internal factors included gender, academic self-concept (ASC), academic motivation (AM), interest to learn (IL), and mental well-being (MW), while the external factors comprised of teacher-related indicators (Teacher), assessment-related indicators (Assessment), learning guide-related indicators (LG) and Knowledge Hub-related indicators (KHub).

The study utilized Structural Equation Modeling (SEM) with SmartPLS software to develop the SLS model and Academic Performance (AP) model. Both online learning platforms used by PSHS CARC, the LG, and KHub, were found to influence student learning satisfaction.

The other important result is that external determinants (LG, KHub, Teacher, Assessment) dominated the SLS models while internal determinants (ASC, AM, IL, MW) dominated the Academic Performance model for the PSHS CARC Chemistry students. The external determinants influence the student's learning satisfaction while the internal determinants influence the academic performance of the Chemistry students. Assessment indirectly affected SLS. Another finding is that gender, LG, and ASC directly influenced AP.

The results validate that online learning tools (LG and KHub) are crucial determinants in ensuring learning satisfaction and academic success in the online learning of PSHS CARC Chemistry students.

Keywords: Student learning satisfaction, Academic performance, Online learning Determinants, Structural Equation Modeling (SEM), SmartPLS.

CHAPTER I

INTRODUCTION

Background of the Study

The COVID-19 pandemic has rendered online learning as the default mode of learning whereas before the pandemic, online learning was an alternative to the traditional classroom face-to-face learning. It was an abrupt remedy to continue the learning process in the academic institutions. Many students have been obliged to adapt to this new learning environment, with some embracing it and others finding it mentally challenging. In this context, the issue of student satisfaction has become a crucial factor in determining the success of online learning. With more students studying remotely, institutions and educators need to guarantee that they are meeting the needs of students and delivering the same learning experience as before. A need to study and explore the factors that contribute to student satisfaction in online learning has become a concern in the world of education as we can no longer turn back time to the way the world was before the pandemic.

From the field of psychology, the concept of satisfaction had been introduced to other fields like marketing where customer satisfaction had become important feedback for better products and sales. Symonds (1955) proposed the concept of learning satisfaction which has captured the attention of educational researchers even to this day. In the marketing field, satisfaction (particularly customer satisfaction) is the degree or level of pleasure experienced by the customers based on their perceptions of the beneficial functions of the product and their product expectations (Kotler, 1997). Applied to the field of education, learning satisfaction is the feelings and attitudes of the learner (towards the individual's learning process and learning experience) which reflect the level of fulfillment during the learning processes (She et al., 2021). Learning Satisfaction may be related to the desire to learn (Topala & Tomozii, 2014), learning motivation (Chang & Chang, 2012), enjoyment of specific activities recommended by the curricular designs (She et al., 2021), course instructor, content, assessment, and schedule (Hew et al., 2020), course content , teaching mode, and learning environment (Xu, 2017). Each individual learner is unique and may have different learning needs and varying levels of learning fulfillment (Chang & Chang, 2012).

While marketing customer satisfaction is centered on the product quality and how it satisfies the customer. It is interesting to note that in education, the customer who is the learner becomes the product. The quality of education is gauged by their academic performance. Learning satisfaction focuses on the level of fulfillment of the learner on the learning process and more importantly on the quality of the learner produced because it determines the prestige and marketability of the institution and its educational programs to attract more customers/students.

Even during extreme or unforeseen situations like the COVID-19 pandemic, the approaches to learning processes and environment may evolve but the learning satisfaction standards of the individual learner remain to be fulfilled to the utmost level. The Covid-19 pandemic greatly disrupted the implementation of educational programs worldwide. To effectively minimize person-to-person contacts and prevent the spread of COVID-19 around the world, a lot of educational institutions had resorted to online platforms to facilitate teaching and learning in schools (Choi & Chung, 2021; Miller, 2020; Sobaih et al., 2021; Wlodarczyk et al., 2021). Most educational systems had to abruptly shift to online or remote learning in teaching preschool up to tertiary level students.

Online classes and technology were developed to become the most important platforms during the lockdown days. Most educational institutions took advantage of the available technologies to find solutions and create new learning environments using the Learning Management System (LMS) for the students to guarantee that learning never stops and the level of learning satisfaction of students is fulfilled as they were during the pre-pandemic times. Curriculums were modified, new instructional materials were created, and activities were planned so that the students remain actively involved through online learning. Similarly, e-learning has ensured quick accessibility to available learning files and folders provided by the teacher or through the internet. The remote mode of learning, aided by the advanced digital technology, has made learning simple, fun, and engaging for most students. Technology-based learning is appealing to the young learners and has proven to be more engaging by making many subjects, which were traditionally considered boring by students, to be interactive and fun. Furthermore, such a remote mode of learning made it possible for students to attend classes from anywhere in the Philippines as both classes and learning materials were easily accessible in their home with available internet connections. Infusing learning platforms with new interactive applications has made online classes more appealing for both students and teachers as more students are able to participate actively at the same time using certain online applications.

The new challenges of maintaining quality education, including learning satisfaction and determining the factors that affect the quality of education, are the most pressing issues during the implementation of online learning that need to be addressed. The importance and benefits of online learning cannot be ignored, but similarly, the issues concerning its implementation are also relevant, especially for young high school learners. Another relevant issue is the effectiveness of online learning and if student satisfaction is being catered to. This research is conceptualized to determine the factors or the determinants of high school student learning satisfaction. This will, to a certain extent, address the effective way/s of delivering online lessons, particularly about Chemistry, to students. Through the student learning satisfaction survey, educators, administrators, and other concerned stakeholders are given insights on choosing the right tools to elevate the academic performance of students, design educational programs, initiate educational reforms, develop appropriate curriculum materials, conduct training for stakeholders, make necessary purchases, construct necessary facilities, and establish networks and linkages.

Online learning is not new as this has been existing for many years now. But this is the first time that it is being globally adopted and implemented to manage the challenges and opportunities in learning due to the Covid-19 pandemic. The advantages of online learning include easy accessibility to knowledge, proper content delivery, content standardization, personalized instruction, self-pacing, interactivity, and convenience (Elshami et al., 2021). Though there are advantages in shifting to online classes, these major changes in teaching and in the learning experience of students brought the education system in the Philippines to the test. While most schools welcome and embrace the implementation of online learning, the perceived quality of student learning using this teaching methodology now becomes a paramount issue.

Several factors affect the effectiveness of online learning (Pratiwi, 2020). Learning satisfaction is critical for an effective and successful learning process because it is the main indicator to achieve the goal of online learning. Kotler's definition of satisfaction (Kotler, 1997) has been used for decades but the definition of satisfaction in online learning is intricate, multidimensional and includes many aspects that can be external or internal (Ramli et al., 2018). Some of these external factors are slow internet, technology support like the quality of learning management system, online learning materials or learning modules, knowledge in the use of technology to both teachers and students, communication, flexibility, workload, instructor pedagogical skills, assessment tools, and feedback. Internal factors could affect students' perceptions, attitudes, motivation, mental well-being, and interest to learn via online platforms (Hammarlund et al., 2015). All these factors influence each other so that it determines the quality of learning outcomes or student performance.

Online learning calls for a greater demand of motivation and self-discipline than the traditional classroom learning. The classroom involves instructors and peers who can have the student responsible for their coursework. In contrast, online learning involves the students setting their own goals, tracking progress, and meeting deadlines. Online learning offers the needed interactions like discussion forums, email correspondence, and one-on-one support. Technology also adds to the learning experience by incorporating interactive visual animations leading to more effective communication and learning. A study by Nguyen (2021) was done to assess the impact of five factors (Instruction, Information, Interaction, Announcement system, and quality of Technology) on the usefulness of Learning management system and the influence on student satisfaction. The result suggests that there is a significant impact of the 5 mentioned factors on learner satisfaction in online learning.

Teachers have been exhausting all their efforts and resources in response to the requirements of this teaching methodology, including preparations of learning guides or modules and elevating their knowledge on the use of various technologies, software, and applications that could be of use to them during this crisis. Efforts to make online learning more like the regular classroom setting that we are all accustomed to include the conduct of asynchronous meetings wherein teachers may use pre-recorded lectures, presentation deck, simulation activities, and virtual laboratories to satisfy the need of students and maintain the quality of online learning.

The education system is being forced to shift in this direction and the teachers will have to adapt. However, as we implement new learning approaches, we also must be cognizant of how our student learners will respond to changes in learning modalities and continue to find satisfaction in this new learning experience. Educators must be able to identify the determinants that could affect the student's ability to adjust to and cope with the new learning environment and experience learning satisfaction. Learning satisfaction will lead to better academic performance (Dhaqane, 2016).

At this point, it is safe to assume that the in-person classroom setup, usually regarded as the traditional setup, is no longer and will no longer be normal even if a cure is found, or a vaccine is developed, for COVID-19. The new normal will be for students to learn the materials online at home with minimal or no to in-person interaction with the teachers or even with their peers. Since the remote learning approach places more accountability on the students for their own learning, the students who are new to this approach may initially be resistant to such a method of acquiring knowledge, as it necessitates them to learn the content knowledge on their own at their homes instead of being taught in a classroom setting by their teachers. Consequently, they are maybe unprepared in doing their learning activities during their asynchronous meeting, which can result in low performance. Remote learning leaves the students to manage and control their learning process. The role of teachers and educators, including academic administrators, is to determine which factor or factors lead to student learning satisfaction in this remote learning mode and take advantage of improving or enhancing such factors with positive influence towards elevating the learning satisfaction of the students. an increasingly large number of institutions and researchers have been employing student evaluation instruments to measure learners' satisfaction levels to monitor and improve the teaching and learning experiences (Arbaugh, 2014; Assodar et al., 2016; Bahati et al., 2019; Rajabalee & Santally, 2021; Rienties, 2014).

Student Learning Satisfaction (SLS) is the students' perceptions of how well a learning factor supports his/her academic learning and academic performance (Zamri, et al., 2021). High SLS implies that the learning factors are effective in triggering students' thinking and learning toward academic success resulting in high grades (Singh & Aggarwa, 2021).

The survey in this study serves to gather the student's perception/response on their own learning satisfaction for each learning factor during this remote learning modality. Several factors may influence the student learning satisfaction, either positively or negatively. Positive influences may cause the student to enjoy learning and learning processes while negative influences may result in the student's complaints about the learning processes.

Also, gauging the academic performance of learners is interesting because the academic performance of the student is a result of both external and internal factors. The prime goal of education is to provide high-quality education which results in well-educated and skillful graduates and institutions are valueless without quality graduates (Abdulkadhum & Adhiem, 2019).

The important element of this study is the determination or building of a model that best represents the learning satisfaction of PSHS Cordillera Administrative Region Campus Chemistry learners with the aid of Structural Equation Modeling. Structural Equation Modeling (SEM) is a multivariate technique used to test and evaluate the direct and indirect causal relationships of variables (Fan et al., 2016). SEM combines two statistical methods: confirmatory factor analysis and path analysis. Confirmatory factor analysis estimates the latent psychological traits, such as attitude and satisfaction while path analysis aims to find the causal relationship among variables by creating a path diagram.

Statement of Problem

Each part of the academic institution (the students, educators, administration, and facilities) appears to be unique and there is a need to determine the Student Learning Satisfaction and Academic performance models that would apply to the PSHS CARC Chemistry students. The importance of determining these models that best represents the learners' satisfaction and predicting the determinants affecting student academic performance are the main goals of this study.

Existing models that predict the influence of online learning on the student learning satisfaction and academic performance may not be applicable to the Philippine Science High School (PSHS) and with the type of students that PSHS has. This study aims to assess the influence of identified determinants of student learning satisfaction and determine the SLS Model and AP Model which best represents these learners. Specifically, it sought answer to the following questions:

1. Which of the following determinants, classified as external and internal, have a direct influence on the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects?

   External Determinants

   a. Teacher (Teacher-related indicators)
   b. Assessment (Assessment tools- related indicators)
   c. LG (Learning Guide-related indicators)
   d. KHub (Knowledge Hub-related indicators)

   Internal Determinants

   a. Gender
   b. ASC (Academic self-concept)
   c. AM (Academic Motivation)
   d. AP (Academic performance)
   e. IL (Interest to learn)
   f. MW (Mental well-being)

2. Which of the determinants have an indirect influence on the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects?

3. Which of the determinants have a direct and indirect influence on the academic performance of PSHS CARC students enrolled in Chemistry subjects?

4. What is the best SLS model that would represent the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects?

5. What is the best AP model which would represent the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects?

Significance of the Study

Chemistry has been regarded as a hard subject for students (Carter & Brickhouse, 1989; Nakhleh, 1992). This perception has been common knowledge during the in-person classes and the difficulty of the subject and its adaptation to online learning may pose additional challenges. This study wants to know the effect of external and internal determinants on student learning satisfaction during online learning. Similarly, this study is also interested in the impact of student satisfaction on the academic performance of students enrolled in Chemistry.

The students admitted to the Philippine Science High School (PSHS) System represent the top high school students in the country in terms of intelligence (IQ) and academic abilities. The challenge to the PSHS administration is to maintain the quality of graduates despite the challenges in the implementation of online learning. Knowing the factors that positively or negatively affect the student's learning satisfaction will mitigate the emerging problems. Many research studies have been conducted to identify these factors, but it is important to note that their applicability may vary across different schools. Specifically, while such research findings may hold true for certain educational institutions, their direct relevance to the Philippine Science High School (PSHS) might be limited. Furthermore, if the reported factors based on the existing research will be the basis alone, the administration may find it difficult to determine which of the factors is significant or insignificant to PSHS students.

This research was undertaken to come up with a student learning satisfaction model and academic performance model in the context of online learning. The findings of this study may serve as useful information in policymaking and in enhancing pedagogical approaches to maintain the quality of education in the PSHS System. Similarly, the findings can help teachers and administrators in implementing practices that can help resolve issues related to online learning.

Teachers**.** These models can help the teachers identify the factors that contribute to student satisfaction, such as the quality of the learning guides, the level of interaction with teachers, the effectiveness of assessment, and the ease of use of the learning management system. By identifying these factors, teachers can make targeted improvements to enhance the online learning experience and improve student satisfaction as well as student academic performance.

Furthermore, the SLS and AP model can also help teachers to identify students who may be at risk of low satisfaction. By analyzing data on student performance and internal factors like academic motivation, interest to learn, and academic self-concept, the study can identify early warning signs of dissatisfaction, permitting teachers to mediate and offer targeted support to these students.

School Administrator**.** The findings can provide valuable insights into the factors that contribute to student learning satisfaction and academic performance. These will enable administrators to make data-driven decisions to enhance the online learning experience.

Researchers. The result of the study would help the education researchers to be mindful and educated of the many possible factors or determinants that may arise particularly in an online setting. The result would serve as a guide or a reference for more studies in the future.

Other Campuses**.** The same model can be shared with other PSHS campuses to implement better and more effective learning strategies too. Findings may be used in policymaking of institutionalizing education systems for learners, teachers, and administrators in each campus.

Most of all, this study would contribute to the limited literature associating the student learning satisfaction and academic performance with the external and internal factors considered in this study.

Scope and Delimitation of the Study

This study was conducted at the Philippine Science High School Cordillera Administrative Region Campus (PSHS CARC) during the school year SY 2021-2022. One hundred sixty-nine students from grade 9 to grade 12 enrolled in Chemistry courses participated in this study. The study focused on the determinants of student learning satisfaction by administering a satisfaction survey to the participants, where they rated their level of satisfaction with various aspects of their learning experience, such as the quality of the learning guides, teachers' quality of instructions, in giving timely feedbacks, administering assessment using the learning management system. Additionally, the study also involved accomplishing survey questionnaires on academic self-concept, academic motivation, interest to learn, and mental well-being. The survey questionnaires were developed by the researcher and validated by experts. During the implementation of the study, Chemistry subject teachers and PSHS Staff were tapped to monitor the synchronous conduct of the survey to all respondents. Orientation on how to implement the synchronous survey was done before its application.

The survey questionnaire extracted quantitative data (Likert scale values) which was analyzed using the SMART PLS software to produce an SLS model per grade level.

The study was limited to only one academic year and one school campus, as the pandemic has made it difficult to conduct research in a wider range of learning environments. This limitation may affect the generalization of the results for other PSHS campuses, academic years, or learning conditions that are not affected by pandemic. Additionally, the focus of the study is only on Chemistry courses, which means that the result may not be relevant to other courses or subjects.

Furthermore, the study does not reflect the perspective of other stakeholders like teachers or parents, who could provide additional insights into the determinants of student learning satisfaction.

Chapter II

REVIEW OF RELATED LITERATURE AND CONCEPTUAL FRAMEWORK

This chapter synthesizes existing research to provide a foundation for further investigation on the effect of external and internal factors on student learning satisfaction during online learning and their subsequent impact on the academic performance of students enrolled in Chemistry courses. Discussion on studies and related literature was presented in this chapter to support the context of this study. The conceptual and theoretical framework of this study is also presented and discussed.

Related Literature

Student Learning Satisfaction in Online Learning

Distance learning, known by various terms such as distance education, e-learning, and online learning, refers to an educational approach where teachers and students are physically separated during instruction, relying on technology to facilitate communication between them (Joaquin et al., 2020). Initially catering to nontraditional learners such as full-time employees, military personnel, and individuals residing in remote areas, distance learning has now gained widespread acceptance and continues to experience significant growth within the educational landscape (Berg & Simonson, 2023).

The internet's rapid development has led many schools to offer online courses as an alternative to traditional face-to-face instruction (Ambika et al., 2021). However, concerns about the quality of online education have arisen. Online education combines distance education with computer-mediated communication, providing a unique learning experience. It offers features such as communication through the Internet, different learner participation, altered social dynamics, and reduced discrimination (Ascough, 2002). Online learning has made higher education more accessible and affordable, attracting students who may not have pursued traditional in-class education (Biance & Carr-Chellman, 2002). Terms like internet education, virtual education, cyber-learning, and asynchronous learning are often associated with online education (Office of Sustainable Development, 2000). Key themes shaping online education include collaboration, connectivity, student-centeredness, unboundedness, community, exploration, shared knowledge, multisensory experience, and authenticity (Kearsly, 2000). Online delivery is characterized by the separation of teachers and learners, the influence of an educational organization, the use of computer networks for content distribution, and two-way communication for student interactions (Paulsen, 2002).

An important goal of e-learning is to deliver instruction that can produce equal or better outcomes than face-to-face learning systems. Several studies have been conducted over the years to identify the factors that affect students' satisfaction and learning outcomes and to examine potential predictors of e-learning outcomes (Saba, 2012).

With the emergence of the coronavirus disease in March 2019, educational institutions around the world were left with no choice but to adapt to the changed circumstances brought about by the implementation of physical distancing measures. Governments took measures to keep the education standards despite the predicaments of the COVID-19 pandemic. As such, there is a need to reinforce the curriculum and respond to the emerging needs of online learners (Toquero, 2020). Several communities must be locked down and quarantined, which resulted in students and teachers studying and working from home.

Amidst the pandemic, online learning has emerged as a highly effective method to facilitate education. The profound impact of the virus compelled the widespread adoption of online education, leading to the closure of schools and the absence of physical interaction between teachers and students (Ambika et al., 2021). The move to online learning is the only way for educational institutions to resume their studies. This shift has brought about a dramatic transformation in education, characterized by the remarkable rise of e-learning (Shahriar et al., 2022). Rather than traditional physical classrooms, teaching is now conducted remotely on digital platforms, revolutionizing the educational landscape. Hazari (2021) stated that the benefits of online learning have not been able to completely satisfy the educational system. A lot of people believe that digital learning formats are not as effective as the real-time classroom teaching-learning process. To counteract this finding, the study of Ruiz et al. (2006) emphasized the effectiveness of online learning and how to maintain it. The study reported that in diverse medical education contexts, e-learning has demonstrated effectiveness comparable to traditional instructor-led methods like lectures. Students perceive e-learning not as a replacement for traditional training, but as a valuable complement, forming an integral part of a blended-learning approach (Kintu et al., 2017). Effectiveness of e-learning involves the development of supporting infrastructure, including repositories or digital libraries to manage access to e-learning materials, consensus on technical standards, and mechanisms for peer review of these resources. The advancements in e-learning technologies indicate a potential revolution in education, enabling personalized learning experiences through adaptive learning, fostering collaborative interactions among learners, and transforming the role of teachers into facilitators of learning and assessors of competency.

Online learning or remote learning incorporates technology in the education process where students are not required to report physically, the use of technology-based instruction is widespread and rapidly becoming common as delivering lessons can be done via the Internet (Barrot et al., 2021). This approach motivates more schools to create online versions of their courses and online synchronous meetings are the only interaction between students and teachers (Lapitan et al., 2021). Synchronous learning is like the traditional classroom but with limited interactions and less assessment (Zheng et al., 2021). The administration of online learning, including the abrupt implementation of Learning Guides or remote instructional materials in the delivery of education, may augment the usual delivery of education. The challenge is to maintain or enhance learning satisfaction of students as well as academic performance.

Student learning satisfaction. Student learning satisfaction is defined as a function of their perceived level of experience and performance with educational services. It is also defined as a feeling or attitude of learners that their desires and needs can be fulfilled in learning activities or processes (Sánchez-Franco, 2009; Topalä & Tomozii, 2014). Student satisfaction is influenced by online distance learning adopted to respond COVID-19 in developing online courses (Almusharraf & Khahro, 2020). Student satisfaction with online learning is highly related to motivation (Tratnik et al., 2019), and commitment to complete a degree online, and success rates (Ali & Ahmad, 2011; Alqurashi, 2019). The quality of education has a substantial influence on the learning satisfaction level and academic performance of students, whether it is delivered through face-to-face instruction or remote learning. Student Satisfaction Survey is useful and effective for education to focus resources on areas, where there is low satisfaction but high importance (Kanwar & Sanjeeva, 2022).

Online classes and technology have emerged as a superhero during the lockdown days but its implication on student learning satisfaction and academic performance is yet to be discovered (*The Impact of Online Classes on Students*, 2021). The lockdown restrictions have resulted in students being disconnected from the outside world, leading to a noticeable lack of exposure (Filho et al., 2021). Disconnection from the outside world may change the perspective of students, affecting their way of acquiring knowledge as well as their attitudes. Salvador et al. (2021) findings reveal noteworthy correlations between academic development and the quality of online classes, course adaptation, workspace conditions, as well as the connection with both fellow students and teachers. Furthermore, there are significant associations between students' emotions and their connection with peers and instructors.

Studies that assessed the student satisfaction level in conventional and online modes have been reported. In conventional environments, Gray and DiLoreto (2016) concluded in their study that what accounted for the significant variance in learning satisfaction of students were the instructor presence, student engagement, learner interaction, course structure, and course organization. According to Dziuban et al.

(2004), several factors have been identified as determinants of student satisfaction with their learning experience. These factors include effective communication from the teacher, the teacher's ability to facilitate and enhance learning, the organization of the course, the teacher's interest and involvement in the students' learning and progress, the display of respect towards students, and accurate assessment of their work. In the context of conventional learning processes, studies have found that student satisfaction with their learning is influenced by the presence of an engaging instructor, active student engagement, meaningful interaction among learners, well-structured course organization, and fair assessment of student work.

A study by Butt and Rehman (2010) examined the satisfaction of the 350 students belonging to various private and public sector universities in light of factors like the expertise of teachers, learning environment, offered courses, and classroom facilities. The student responses on the questionnaires were assessed via regression analysis and showed that the satisfaction of students was significant and positive influence in all attributes with varying degrees of impact. It should be noted that teachers' expertise was the most influential variable among all the attributes.

Renadewa et al. (2021) made a literature review of 40 empirical studies on the indicators that impact online learning efficiency and how it influences student satisfaction and student commitment to learn. The results revealed that academic concerns, accessibility concerns, technological skills, mental well-being, and teacher commitment are the factors that impacted the depreciation of efficiency of online learning, student satisfaction and learner commitment during the pandemic period.

Yekefellah et al. (2021) found that the difference in the satisfaction with e-learning before and after the pandemic period was significant. Previous attendance in online classes and gender were determined as the main factors. The mean scores among satisfied students were higher than unsatisfied students.

Dziuban et al. (2015) reported that there are three underlying satisfaction components of student satisfaction in the online learning implementation. These are engaged learning, assessment, and agency. The scores comparison showed that satisfied students characterize important differences only in the two components: agency and engaged learning. These results indicate that the students and teachers predetermined expectations for online learning are vital considerations in relation to student satisfaction.

Bangert (2006) recognized four indicators of satisfaction in online learning. They are (1) interaction and communication among student and teacher, (2) tasks allotted of time, (3) engaged and active learning, and (4) student learning cooperation.

Barbera et al. (2013) identified factors that are more influential on the satisfaction of student learning and student perception of their learning. The responses of the social science students from the USA, Spain, and China to the questionnaire were subjected to correlation and ANOVA analysis. They found that the course design and content were the most critical factors in the perceived learning and satisfaction of the students.

Khan and Setiawan (2019) did a review and critique of different research topics and methodologies related to e-learning. The review process involved three steps: article searching and retrieval, filtering and sorting, and final inclusion. The findings indicate that e-learning has had a positive impact on student perceptions, communication, educational quality, critical thinking, and self-directed learning.

Furthermore, the results also highlight the significance of teachers' responsibilities and students' satisfaction in higher education when implementing e-learning.

In the study of Yang and Cornelius (2004) participants were asked to assess the overall quality of the online education they received. Their responses indicated a moderate level of satisfaction. This implies that students were not entirely content with the education they received online and did not perceive it to be of high quality. Similarly, the above cited literature also showed moderate acceptance of online learning during the pre-pandemic. It is possible that the participants' individual personalities influenced their sense of responsibility for their own learning. In addition, online learners during the pre-pandemic already showed issues like lack of self-motivation, excessive phone usage, or passive learning and this affected their educational experience. Yang and Cornellius (2004) upon examining the negative experiences of students, found out that all factors, except those associated with learner characteristics (such as lack of self-regulation or self-motivation), were attributable to the online instructor.

The study of Febrianto et al. (2020) aimed to investigate the process of online learning and identify the obstacles encountered by students during pandemic. The findings indicated that not all students preferred online learning and expressed dissatisfaction with its effectiveness. Social, economic, and cultural factors emerged as significant indicators of the challenges faced in implementing online learning in various regions of Indonesia. In many rural communities, traditional methods of learning are still favored, and the adoption of online learning is hindered by technical limitations, inadequate infrastructure, and the need for proper human resources to embrace innovative learning models in Madura Island.

Though there were problems that were encountered during the implementation of online learning, we cannot set aside that online learning helps the education system to move forward (Berg et al., 2023). Teachers made sure that the learning for students was not compromised, so they took a great leap forward to find solutions and create new learning environments for their students to ensure that learning never stops. Given limited preparation time, educators swiftly adapted by modifying curricula, developing new lesson plans, and organizing engaging activities to ensure their students' active involvement in online learning (Dhawan, 2020). As students experienced increased isolation and disconnection in the new online learning setting, the importance of engaging them in their educational journey became even more pronounced. Consequently, it is crucial to explore effective approaches to foster learner engagement. Student engagement serves as a quality indicator for higher education institutions that have embraced online learning, as it strongly influences the successful completion of online courses (Redmond et al., 2018).

While certain students excel in the dynamic online learning environment facilitated by teachers, others may benefit from periodic support to fully participate. This underscores the importance of identifying the factors that influence student satisfaction with their learning experience. Vaghjee & Vaghjee (2022) stated that Online learning, like traditional learning environments, does not adhere to a specific pedagogical design. Just as educators employ diverse instructional methods based on course objectives, student academic levels, and subject areas in traditional settings, the same principle applies to online learning. In certain courses, online learning is employed as a supplement to face-to-face lectures, incorporating instructional materials through virtual platforms or other technological communication mediums. During Covid-19 pandemic, schools had to adapt the educational process for exclusively online teaching and learning (Coman et al., 2020). Therefore, it is essential to provide support to students in order to sustain or enhance their satisfaction and engagement, ultimately fostering an effective learning process.

Most private and public schools have effectively adopted online platforms such as Zoom, Google Classroom, Microsoft Teams, and various others, although certain institutions continue to encounter notable difficulties in this transition. The challenges associated with online learning are diverse and multifaceted (Chang et al., 2014).

According to the findings of Basar et al. (2021), it was observed that 93% of students with computers or smartphones and have access to the internet at home revealed a high level of proficiency and comfortability to use computers. However, 41.5 % students exhibited low motivation towards online learning and 66.7% students displayed a moderate level of ability to work effectively in group settings. Furthermore, 98% students agreed that traditional face-to-face teaching was crucial for their learning process.

Joaquin et al. (2020b) account some factors that affected online learning. This encompasses teacher readiness, learner circumstances and context, and the effectiveness of the learning environment. Additionally, alongside the evident concerns of internet speed, material costs, and delivery methods, it is crucial to adopt a comprehensive approach.

The findings of the study of Rehman (2021) indicated that university support, instructors' support, and motivational factors were significant predictors of the quality of online learning. However, the relationship between instructors' support and motivational factors, as well as the quality of online learning, was negatively influenced by situational factors. Interestingly, the relationships between university support and the quality of online learning were not affected by situational factors, suggesting that they remained consistent regardless of the specific circumstances. Maheshwari (2021) indicates in his findings that institutional support and the perceived enjoyment or satisfaction experienced by students have a significant impact on their intentions to continue studying the course online. Instructor's support or teacher's support play a vital role in maintaining student satisfaction in online learning. To mitigate these challenges and keep students engaged, teachers have exerted considerable effort to create online classes that are concise, engaging, and interactive (Saleem et al., 2022). Internet connectivity and ease of use of online platforms plays a vital role in making online classes effective. Numerous studies have consistently demonstrated that the ease of use, accessibility, and speed of transmission of online media and mobile devices play a crucial role in the learning process. The enhanced adaptability of online learning can be attributed to the improved accessibility, leading to positive outcomes (Pham et al., 2021).

Ramli et al. (2018) found out that internal factors and the self-directed learning process of students are significantly influenced by the external factors. In addition, they also found out that external factors have a direct impact on internal factors while external factors have an indirect impact over self-directed learning readiness.

Adesoji (2008) conducted a study to identify internal and external factors affecting students' attitudes toward science, specifically Chemistry. The internal factors such as age, gender, student cognitive styles, social view of science and its social implication, career interest, and achievement were found to affect the Chemistry performance of students. External factors such as methods of teaching, attitude of the teacher, and parental influence were also found to affect the chemistry performance of students. In addition, the study of Basuony et al. (2020) reported several factors significantly impact students' satisfaction with online learning. These factors include the internet connection, online learning platform, class schedule, student interest, motivation and self-motivation, and the use of online exams as an assessment method.

Goh et al. (2017) examined the relationship between students' experiences in e-learning and their learning outcomes and satisfaction. It identifies course design, interaction with the instructor, and interaction with peer students as predictors of learning outcomes and satisfaction. A questionnaire was distributed to students at a Malaysian university, with 670 valid responses collected. The results indicate that course design, instructor interaction, and peer interaction positively influence learning outcomes and satisfaction. Notably, interaction with peer students has the strongest impact. The study emphasizes the importance of designing e-learning courses that optimize students' experiences to enhance their learning outcomes and satisfaction, highlighting the role of university administrators and instructors in this process.

Amka and Dalle (2021) investigated the e-learning readiness and satisfaction of students with special needs using the community of inquiry (COI) model. By surveying 178 special needs students from various Indonesian universities, the research found that determinants such as teaching presence, cognitive and social interaction, and content quality directly and indirectly impact their satisfaction with e-learning. This extended model provides educators with insights into effectively utilizing e-learning as a pedagogical tool, particularly for special needs students. The study also suggests important policy implications and directions for future research in this area.

Rahman (2016) investigated the satisfaction levels of 142 gifted students enrolled in the Najran Centers for Gifted in Saudi Arabia. A questionnaire was used to gauge satisfaction across different aspects. Results revealed high satisfaction with administration and teachers, while enrichment activities, teaching methods, student relationships, and facilities garnered moderate satisfaction. Gender and schooling level didn't significantly affect satisfaction levels.

Jin and Moon (2006) compared the psychological well-being and school life satisfaction of academically talented adolescents in a residential science high school in Korea with those in regular high schools. 299 high-ability students, divided into science high school (111 students) and regular high school (188 students) groups, participated. Both groups completed Psychological Well Being scales and a School Life Satisfaction scale. The science high school group showed significantly higher school life satisfaction, but no significant difference in psychological well-being. Students from the science high school appreciated the advanced curriculum, teacher expertise, and positive relationships with teachers and peers. The study concluded that the science high school met the educational needs of talented students better than traditional high schools, though it didn't confirm the assumption that specialized schooling enhances psychological well-being.

Swan et al. (2015) examined a virtual learning lab (VLL) in a rural school district created in 2011 for exceptional, gifted middle school students. The study involved methods like focus groups, observations, interviews, and document reviews. Findings revealed that VLL programming, particularly online instruction integrated into traditional public schools, effectively provided advanced coursework. Benefits included cost-effectiveness, parental and student satisfaction, and personalized learning pace. VLLs hold promise for catering to gifted students within mainstream education.

There are many studies made and reported on the effect of external and internal factors on the learning satisfaction of students. The cited literature focused on the determinants of student learning satisfaction in both traditional and online learning. Among these, are teacher's related determinants, assessment related determinants, learning guides, learning management system, motivation, self-concept, academic performance, interest to learn, mental well-being and gender. These determinants are classified as external and internal determinants in this study.

***External determinants*.** Brown (2007) defined external determinants as those that come from "outside" the individual or those that are based on circumstances outside of the influence and control of the person. The external factors in this study include teachers-related indicators, assessment-related indicators, learning guides, and the knowledge hub/ learning management system used to implement online learning.

The study of Yang and Cornellius (2004) explained the implications of positive and negative experiences to online learning. Revealed factors affecting learning satisfaction were flexibility, cost-effectiveness, electronic research availability, ease of connection to the Internet, and well-designed class interface were students' positive experiences. The students' negative experiences were caused by delayed feedback from instructors, unavailable technical support from instructors, lack of self-regulation and self-motivation, the sense of isolation, monotonous instructional methods, and poorly designed course content.

Teacher (Teacher-related indicators). Teacher-related indicators are the observable attributes of the Chemistry teacher in conducting online learning. Teacher as a determinant encompasses the expected teacher role (duties, responsibilities, conduct and facilitation of the teacher of the remote learning), the teacher's competency in the subject, communication skills, target expectations required of the PSHS teacher (punctuality and timeliness in giving feedbacks to the students) including being perceived as considerate and fair in giving grades.

Teacher and student learning satisfaction. The teacher's role in administering the remote learning is important to guarantee that students are engaged, motivated, and making progress towards their learning goals. Responsibilities such as designing and delivering instruction, providing feedback, monitoring student progress, facilitating discussions, fostering a sense of community in virtual classrooms, and supporting student well-being (*Online Teacher Responsibilities*, 2017). They must also be available to answer student questions and provide support, even if this means working outside of official office hours. Teachers' presence increases student satisfaction in online learning.

The study of Li (2022) using correlation and regression analysis of the questionnaire survey reveals a strong connection between the teacher's strategies and various factors, including teaching presence, social presence, and cognitive presence. These strategies effectively promote students' online interaction and ultimately contribute to their high levels of satisfaction. Furthermore, the analysis indicates that teaching presence exhibits a stronger relationship with cognitive presence compared to social presence.

Eom et al. (2006) recognized indicators critical to the learning satisfaction of the students in relation to their interactions with their teacher. The study emphasized the demand of the students for regular feedback from their teacher, effective conduct of course learning, and teacher course content mastery.

Student-teacher interaction which may affect student learning satisfaction in online learning involves asynchronous communications (discussion boards and email) and synchronous communications (Live chat and video conferencing). Both synchronous and asynchronous interaction requires two-way communication between the student and teacher. Murphy & Rodríguez-Manzanares (2009) reported that the student learning satisfaction is positively affected using the two forms of interaction (synchronous and asynchronous).

Teachers must possess strong communication skills and must have the ability to use various tools and technologies to engage students and support their learning (Evans, 2023). Teachers are expected to adapt their instructional approaches to satisfy the requirements of individual students and use appropriate methods to monitor student progress and provide personalized feedback (*Teacher Digital Learning Guide - Office of Educational Technology*, 2021). Even though students are ultimately responsible for their own learning, the roles teachers assume as instructors are critical in guiding students' thinking and behavior. Teachers can take on a variety of roles in their teaching (e.g., synthesizer, moderator, challenger, commentator). In face-to-face learning, the teacher's influence is paramount as the teacher has control and management of the classroom, the implementation of the curriculum, the assessments, and even the students (Carnegie Mellon University, n.d.). In remote learning the role of teachers became significant though student-teacher interaction has diminished in online platforms such as Zoom meetings and Google Classrooms.

Fatani (2020) in her study on the effectiveness of the use of video conferencing during the COVID-19 pandemic concluded that video conference teaching positively influences student satisfaction. In essence, student satisfaction with video conference teaching is primarily due to the teacher's presence and effectiveness in teaching, cognitive engagement, and social interaction, rather than solely relying on the technology used.

Cole et al. (2014) study evaluated the satisfaction levels with online learning of 553 undergraduate and graduate online students. The data results showed that 46% of the respondents were satisfied and they indicated convenience, learning preferences, and structure as the reasons for learning satisfaction. Of the 54% of students who were not satisfied with their online courses, lack of teacher and peer interaction was the highest source of dissatisfaction. Another 8% of respondents were not satisfied with how teachers facilitated online learning.

The study by Celia Lo (2010) showed that the teacher’s role is a vital element in the learning satisfaction of the students. The study showed that when both teachers and students alike share in the responsibility for learning, the students expressed high satisfaction levels. Mtebe (2018) also reported that teacher quality had a positive influence on students' satisfaction.

The study of Naseer and Rafique (2021) reported that the academic support received by the undergraduate students at different universities in Punjab, Pakistan from their teachers is a moderating factor for the student's satisfaction with their online learning.

Bolliger and Martindale (2004) also corroborated that the teacher is the main predictor of student learning satisfaction. In their study, strong student learning satisfaction is correlated to the performance of the teacher which includes the teacher's availability for the students and the teacher's response time to them.

The paper of Snopce, H. and Alija, S. (2018) focuses on factors influencing student satisfaction, including their needs, learning outcomes, and motivation. The analysis emphasizes the importance of teaching quality and the social environment provided by the university in determining student satisfaction. The study explores the relationship between satisfaction factors, student performance, and persistence. It examines various variables such as personality, cognitive abilities, academic achievement, and motivation constructs in relation to different aspects of satisfaction. The research utilizes a combination of qualitative and quantitative methodologies, with survey data collected from students at the Southeast European University. The results were analyzed using the Statistical Package for the Social Sciences.

Whether traditional face-to-face learning or online learning, instructors hold a crucial role in the learning process of students. Their attitude towards online learning, knowledge base, proficiency in instructional design, organization of teaching activities, and interaction with learners significantly impact students' satisfaction with online learning. Costley and Lange (2016) conducted a quasi-experimental study to examine the impact of instructor control on students' online learning satisfaction and discovered that instructor control through instructional design had a positive effect on students' perceived online learning satisfaction. Overall, instructors' online teaching ability stands as the primary factor influencing students' learning satisfaction, as supported by the research of Liu et al. (2015) and Bao et al. (2016).

***Teacher and academic performance*.** Igwe (2017) found that the classroom management behaviors of the teacher had a high positive impact on the interest, attitude, and achievement of the students in Chemistry. In this study involving 397 students, it was suggested that teaching Chemistry lessons can be made exciting through suitable integration of practicals, cordiality, and the use of instructional materials. Furthermore, Igwe recommended that to make the students advance the same attitudes for improved achievement in chemistry. A positive attitude towards the teaching of Chemistry should be demonstrated by the teachers.

The study of West (2016) investigated the impact of teachers on students' academic performance and non-cognitive outcomes, such as self-efficacy, happiness, and behavior in class. Data from teachers in four urban school districts were analyzed, focusing on the relationship between individual teachers and students' Math performance and non-cognitive factors. The study also examined the influence of different dimensions of teaching practice on student outcomes. The findings indicated that upper-elementary teachers had significant effects on various aspects of students' attitudes and behaviors, in addition to their academic performance.

Gilbert (2018) investigated the relationship between student performance, teacher communication orientations, and student communication preferences. The study involved training teachers in the Process Education Model and collecting data from 21 teachers and approximately 200 students in an independent school. The results indicated that most teachers had intrinsic communication orientations, while students' communication preferences varied. The performance data, measured by Grade Point Averages (GPAs) and Activated Clotting Time (ACT) instruments, showed significant differences between students classified as "easy to communicate with" and "difficult to communicate with," with the former performing better. However, no significant differences were found on the ACT Aspire for students in grades 6-9. These findings suggested that teacher communication orientations and student communication preferences may impact student performance, particularly in GPAs and certain ACT measures.

Bonney et al. (2015) investigates the relationship between teacher quality and students' academic performance in Sekondi Takoradi Metropolitan Assembly (STMA) Junior High School. The research adopts a descriptive survey design and involves Junior High School teachers and pupils in the metropolis. The study randomly selects five educational circuits in the metropolis and collects data from a sample of 500 participants using a questionnaire. Data analysis techniques include Pearson Moment Correlation, ANOVA, means, percentages, and standard deviations. The findings revealed that while teachers have high academic and professional qualifications, their teacher quality does not significantly affect the student academic performance.

The cited literatures generally highlight the positive impact of teacher-related indicators on students' learning satisfaction and academic performance. However, there are several gaps identified in the studies. It lacks specific evidence or examples to support the claim of a strong connection between teacher strategies and factors like teaching presence, social presence, and cognitive presence. The role of technology in influencing student satisfaction is not thoroughly explored, despite some literature suggesting that teaching, cognitive, and social presence of the teacher are more influential than technology itself. The statement also fails to provide context or explanations for the reported lack of teacher and peer interaction in online courses, which is identified as a significant source of student dissatisfaction. Furthermore, while it assumes that strong communication skills and the use of various tools and technologies are necessary for engaging students and supporting their learning, specific evidence, or examples to substantiate this claim are lacking. Addressing these gaps by providing more specific evidence, discussing the role of technology, explaining the lack of interaction, and offering supporting examples would strengthen the understanding of student satisfaction and academic performance in relation to teacher-related factors.

Assessment (Assessment-related indicators). Assessment-related indicators are selected attributes of ideal assessment tools and activities required in their Chemistry subject. Assessment as determinant includes assessment characteristics like clear instructions and directions, amount, or number of activities, enough time allotted to complete the activities, and acceptable deadlines set for submission.

Assessment tools are necessary to gauge student learning and academic performance whether face-to-face or remote learning. The Ofsted Handbook (2022) states that: *“When used effectively, assessment helps pupils to embed knowledge and use it fluently and assists teachers in producing clear next steps for pupils.”*

Assessment is the process of measuring what students know and have learned from their educational experience (McDaniel, 2017).

Assessment and student learning satisfaction. Bolliger and Martindale (2004) emphasized the importance of assessment, particularly feedback on assignments as it keeps the learners involved and motivated. The study of Asad et al. (2021) used quantitative research to determine the correlation between student satisfaction and e-assessment in their English as Second Language (ESL) academic performance. The research tested two kinds of assessment used in their teaching ESL: the traditional assessment (multiple-choice questions, fill-in-the-blanks, true and false statements, constructed response questions, and extended response questions) and the computer-based electronic assessment. Findings showed that in the close-ended questionnaire, the difference between the traditional and electronic assessments was not significant. However, in the open-ended questionnaire, the difference between the two assessments was significant.

Conducting assessments online has become easier today as there is no requirement of using the paper-and-pencil. Though online assessment is easier, some studies concluded that learning satisfaction is affected. Noor et al. (2022) found out that students were not satisfied with the online assessment due to technical issues that affected their performance. Al-Maqbal and Hussain (2022) study identified several challenges associated with implementing online assessments. These challenges include learners' reluctance to turn on cameras, increased teaching workload, cheating incidents, time-consuming development of online assessment instruments, issues with impersonation and dishonesty, difficulty in assessing practical experiences, instances of plagiarism, grade inflation, assessment of group work, maintaining academic integrity, and handling many students per section. These challenges were found to potentially undermine key assessment principles such as validity, efficiency, fairness, reliability, and variability.

Challenges in implementing assessment in online learning hinder student satisfaction but there were studies that reported its positive implication. The positive impact of technology on the education sector is undeniable. One notable advantage is the ability to carry out teaching and evaluation activities beyond the confines of a traditional classroom. With the help of computers and the internet, these tasks can be conducted at any time and from any location. Bahati et al. (2019) found out that students expressed satisfaction with the quality of their engagement and the feedback provided in all formative e-assessment activities. The findings indicated variations in student satisfaction between and within different formative e-assessment strategies. However, there was a minimal difference in mean ratings of student satisfaction among all formative e-assessment strategies, making it challenging for researchers to identify a clear preference. Additionally, learner satisfaction with various formative e-assessment strategies showed positive correlations at different levels, but no relationship was found between students' scores on the final course exam and their satisfaction with formative e-assessment strategies.

Dziuban et al. (2015) reported that satisfied students are characterized by an ability to assess and monitor their progress and indicate that a timely response by the instructor plays an important role in their satisfaction. Online students incorporate three dimensions into their evaluation process of online learning experiences: 1) engaged learning with various course elements, 2) a sense of agency, and 3) an efficient assessment of academic progress. With the online examination, results are being immediately distributed, which relieves students' stress and anxiety (Guru, 2021).

Assessment and academic performance. The study of Osabutey et al. (2022) demonstrated a positive relationship between the use of online assessments and students' academic performance. Furthermore, the experimental results indicated that students tend to achieve better outcomes when utilizing online assessments compared to paper-based assessments.

Mitra and Barua (2015) found out that the implementation of computer-based formative tests with automated feedback resulted in enhanced performance for students with stronger academic backgrounds in the summative assessment. As a result, integrating computer-based formative tests into the curriculum of pre-clinical integrated medical programs could be considered as an optional addition to boost the performance of students with higher academic abilities. The use of online assessment has a positive impact on students' academic performance. The findings also indicate that students perform better using online assessments than paper-based assessments (Osabutey et al., 2022; Rane & MacKenzie, 2020)

According to the survey of Chakraborty et al. (2021), 48.0% of learners agreed that online assessments have evaluated their knowledge properly, but 45.2% of learners mentioned that online assessments have weakly evaluated the knowledge of learners.

In a study conducted with American high school students, Jax, Ahn, and Lin-Siegler (2019) explore the effectiveness of assessment as learning, where students assess their own learning process and products. They specifically investigated the impact of contrasting case-based instructional supports on students' accuracy in self-assessment and academic performance in physics. The study compared three groups: (1) students provided with content knowledge and contrasting good and poor solutions, (2) students provided with content knowledge and good solutions only, and (3) students provided with content knowledge only. The results showed that students in the contrasting case group demonstrated improved accuracy in self-assessment, mastery of content learning, and development of self-assessment strategies.

The cited literature explores the impact of assessment on learning satisfaction and academic performance of students. Findings revealed that both close-ended and open-ended questionnaires were used to assess traditional and electronic assessments, yielding different results. This discrepancy calls for further investigation. Online assessment shows a positive impact on academic performance and aligns with student satisfaction with formative e-assessment strategies. However, the discussion lacks specificity regarding the assessments being compared, fails to provide details on technical issues affecting online assessment, and lacks information on the specific impact of formative e-assessment strategies on learner satisfaction. Based on the literature specific impact on learner satisfaction and academic performance limits the ability to draw meaningful conclusions. The need to do further study to answer the gaps was the reason for this study to include assessment related indicators.

Learning guide (Learning Guide-related indicators). Learning Guide-related indicators refer to the use of learning guides implemented during online learning in PSHS CARC. The learning guides are used to “guide” the students in their online Chemistry learning during the pandemic period. Learning guides are modules for student learning which are structured and formatted by the teachers in such a way that the students feel the teacher is guiding them through their lessons.

Traditional learning involves direct teaching, and its advantage is that students are acquiring and developing concepts or skills in a subject directly under the supervision of the teacher. In an online mode, the learning guide becomes the medium on which the teacher imparts the learning concepts and skills to the students (De, 2021). Learning guides are instructional materials or resources that provide students with step-by-step guidance and support in achieving their learning goals (Learning and Teaching Materials | Unesco IIEP Learning Portal, n.d.). They are designed to be used independently or in conjunction with other instructional materials, such as textbooks or lectures. During online learning, these learning guides focus on how these resources contribute to the perceptions of the students on the quality and effectiveness of their learning experiences.

In an online learning mode where the teacher-student interaction is limited, the use of learning guides for the student is an important tool. A learning guide is a user manual for students designed specifically to guide the students to learn the subject matter and skills in a course effectively (Learning Guides, 2022). Learning guides is a tool in enhancing learning strategies during the COVID-19 pandemic.

Whether online or face-to-face mode of learning, the common aim is to engage the students in the learning process motivating them towards higher-level critical thinking by increasing their focus and attention. Teachers implemented the use of these learning guides to allow more chances for student engagement to successfully achieve the course's learning objectives.

Learning guide and student learning satisfaction. Rabajalee and Santaly (2020) analyzed student feedback in the implementation of online modules in the learner’s satisfaction and engagement over 844 freshmen university students across various disciplines (Engineering, Science, Humanities, Management, and Agriculture). They reported significant and positive relation between satisfaction and engagement. However, the correlation of both satisfaction and engagement in relation to the overall performances of the students was weak positive significance.

Ansari (2011) used an 18-item questionnaire to assess the use of modules in the health and social care education courses to determine the factors associated with student satisfaction with their educational experiences and their achievement in their modules. The study quantitatively evaluated three satisfaction indicators: index, extent, and overall satisfaction. Higher overall satisfaction in the use of the module was significantly correlated with higher academic performance which is equated to their grades.

The utilization of modules or learning guides has been found to elicit a positive perception among students. The implementation of modular learning proves beneficial in online learning, as students engage in individualized learning using these guides. However, it is worth noting that studies have also reported instances of negative perception in relation to modular learning or learning using modules/learning guides.

The study of Bordeos (2021) was to examine students' attitudes towards the implementation of Modular Distance Learning (MDL) in remote learning and their perceptions of its effects on learning and engagement, in comparison to face-to-face learning. A quantitative survey employing a 5-point Likert-type scale was administered to assess students' attitudes and perceptions regarding the implementation of MDL during the COVID-19 pandemic. The findings revealed that students recognized MDL as a supportive mode of instructional delivery during the "new normal" teaching but encountered several challenges in its implementation. As a result, students displayed a negative attitude towards the implementation of MDL and perceived it as having a detrimental impact on their learning experience and motivation to learn.

Abando (2022) study employed face-to-face interviews as the method for data collection. The thematic analysis approach, specifically coding of themes, was utilized to filter and gain a comprehensive understanding of the various perceptions of participants regarding Modular Learning Delivery (MLD) in a public school in Paracale, Camarines Norte. The findings revealed that most of the participants perceived MLD to be challenging, particularly in terms of navigating materials and devices. Issues arose when there were insufficient and unstable resources for the reproduction of modules, considering the large number of learners. The participants also identified several challenges, including financial constraints, communication difficulties when distributing, retrieving, and checking modules with both parents and learners, low comprehension levels among learners, lack of available communication devices such as mobile phones, limited internet connectivity, and distant home locations.

Salamuddin (2021) study aimed to assess the perceptions of students at Mindanao State University - Sulu regarding their experiences with face-to-face learning and MDL approaches. The research sought to identify factors that can influence both learning approaches and determine if there is a significant difference in students' perceptions between the two methods. The study utilized a random sampling technique and a survey questionnaire administered to a representative sample of at least ten percent of the university's total enrollment across seven departments during the 2020-2021 academic year. The findings indicated that students agreed on the significant contribution of face-to-face learning to their education but disagreed on the effectiveness of MDL. They also acknowledged the presence of factors that can impact their learning experience in both approaches.

Sutherland et al. (2019) focused on exploring the relationship between student satisfaction and the quality of module teaching in UK business schools. The study analyzes data from undergraduate and postgraduate students using the module evaluation questionnaire. The results highlight several key factors that significantly impact overall student module satisfaction. The most important determinant is the helpfulness of lectures and seminars, followed by the integration of the module with other course elements, the usefulness of online materials, and the appropriateness of summative assignments. However, readings and feedback on formative assignments have a weaker influence on satisfaction, particularly among post graduate students.

Learning guide and academic performance. The findings of Rienties and Toetenel (2016) provide strong evidence highlighting the significance of learning design (guide) in predicting and comprehending the behavior and performance of students in blended and online learning environments. Consistent with advocates of social learning theories, the primary factor in predicting academic retention was the amount of time learners devoted to communication activities, while accounting for different institutional and disciplinary variables. To enhance academic retention, Rienties and Toetenel (2016) suggested incorporating suitable and well-designed communication tasks that align with the course's learning objectives.

The study of Argallon et al. (2022) indicated that there was no significant difference in the perceived effects of MDL among students when categorized by gender. This suggests that both male and female students had similar perceptions of the modular approach. However, a significant difference was observed in the perceived effects of MDL when students were categorized based on their grade level. This indicates that students' perceptions varied depending on their specific grade level. The study suggests that the modular approach effectively enhances students' perception of the learning modules.

Dargo and Dimas (2021) evaluated the impact of MDL on students' academic performance in rural areas during the COVID-19 pandemic. It employed a mixed-method approach, including quantitative analysis of students' General Weighted Average (GWA) and qualitative interviews with parents, learners, and teachers. The results showed a significant decrease of 2.25% in students' GWA after the implementation of MDL. While MDL strengthens family bonding, promotes independent learning, and is cost-effective, it also presents challenges such as increased workload for working parents, limited teacher-learner interaction, and reduced socialization opportunities for students.

Betlen (2021) provided a comprehensive review of articles examining the impact of the MDL on students' academic achievement. The review specifically focused on articles published between 2016 and 2021. The findings and conclusions of the reviewed articles consistently indicated that implementing a modular learning approach has led to significant improvements in students' academic achievement. The paper aims to highlight the positive effects of the MDL on enhancing students' academic performance.

The literature cited reveals several gaps in the research. Firstly, there is a lack of exploration regarding the specific challenges faced during the implementation of modules or learning guides in online learning. Additionally, there is insufficient information regarding the negative perception and the detrimental impact of using learning guides on the learning experience and motivation to learn. The literature also lacks a comprehensive examination of the effectiveness of online materials in the learning satisfaction and academic performance of students. Furthermore, there is a limited focus on the influence of readings and feedback on formative assignments on student satisfaction when using learning guides.

Considering these gaps, the present study aims to address and fill these research deficiencies. It intends to investigate and provide insights into the challenges encountered during the implementation of modules or learning guides, as well as the negative perceptions and their impact on student motivation and learning experience. Additionally, the study seeks to thoroughly examine the effectiveness of online materials. By addressing these gaps, the present study contributes to the existing literature and further corroborates previous findings.

Learning management system/ knowledge hub (Knowledge Hub-related indicators). KHub was used to complement the learning guide in the online learning experience of the students, The PSHS system also implemented a learning management system LMS) which they called the Knowledge Hub. The important features of this PSHS LMS towards assisting the students in their online learning are referred to as the Knowledge Hub determinants.

Educational institutions had resorted to implement measures in compliance to limiting the number of people (students, teachers, and administrators) to be in school at a given time. The need to implement alternative methods to continue the teaching and learning activities without sacrificing the safety of everyone becomes one of the most important platforms. The LMS was introduced to make online learning accessible to everyone. A LMS is an online platform that provides students with access to course materials, assignments, assessments, and communication tools (Kirvan & Brush, 2023). The LMS also tracks student progress and performance, facilitates collaboration and interactions among students, and provides feedback and support from teachers.

In an online learning environment, LMS is an important complementary and supplementary tool for the learning of students. Student learning satisfaction of the KHub is determined by the students' learning experience using the LMS. Their perception of the quality of instructions, relevance of the course content and the effectiveness of the learning activities greatly affect their learning experiences. Similarly, accessibility, response Time, ease of navigation, ease of Use and notification features were the characteristics of an LMS that may affect learning experiences of students.

Learning management system and student learning satisfaction. Ohliati and Abbas (2019) measured the learning management system student satisfaction conducting a research study to find out whether there is an impact of some features of LMS like quality (information, communication, service, and system), usefulness, and ease of use on the student satisfaction of about 100 students in a university. They applied partial least squares as their statistical method. Of these LMS features, service quality, information quality, and ease of use showed significant influence on the learning satisfaction of the students. They also noted that the most dominant feature of the learning management system that affected the satisfaction of students was service quality.

Alkhateeb and Abdalla (2021) employed simple and multiple regression to analyze the data gathered over the 372 questionnaire-survey on the factors of students' satisfaction toward implementing the LMS, Moodle, at the Palestine Technical University-Khadoury (PTUK). Six potential factors were analyzed (Ease of use, Usefulness, Information quality, System quality, Service quality, and Computer self-efficacy) and results showed that all these factors had a significant effect on learning satisfaction of the students in the use of the LMS.

LMS has been implemented in universities and other schools in Hong Kong. A study about student satisfaction with LMS in relation to their belief and use was initiated by Yuen et al. (2019). The study reported the LMS satisfaction of 1179 students from 25 Hong Kong schools over time. Both LMS use and belief were found to have positive linear growth over time. Longitudinal latent growth modeling was applied to evaluate LMS use and belief changes over time.

The study conducted by Nasir et al. (2021) investigates the factors influencing students' satisfaction with the Unitar Education Core (UNIEC) Virtual LMS in blended learning courses. The research considers perceived ease of use, facilitating conditions, and interaction as independent variables. A quantitative approach was employed, utilizing a questionnaire with 17 closed-ended items on a 5-point Likert scale and one open-ended question. The data analysis revealed a statistically significant correlation between facilitating conditions, perceived ease of use, interaction, and student satisfaction with the LMS. The findings suggested that participants found it easy to access the UNIEC Virtual features without training and displayed confidence in their computer skills. Additionally, students reported no difficulty in navigating the website interface. They perceived that course notes, forums, and assignments on UNIEC Virtual positively contributed to their learning outcomes. Active participation in discussion forums and engagement with peers and lecturers were also enjoyed by the students.

Nguyen (2021) investigated the factors influencing learner satisfaction with LMS, specifically Blackboard and Edusoft, at International University - Vietnam National University Ho Chi Minh City. A quantitative survey was conducted among current students to assess the impact of four factors (Announcement system, Instruction information, Interaction, and Technology quality) on the usefulness of the learning management system and its subsequent impact on student satisfaction. The findings indicate that these factors significantly influence learner satisfaction, both directly and indirectly.

Naveh et al. (2012) proposed a new approach to assessing the effectiveness of LMS in higher education. They emphasize the importance of student satisfaction as a measure of success and introduce a lens of critical success factors for evaluating LMS effectiveness. The study, which involved a survey of 8425 students and interviews with 40 students, identified five critical success factors that enhance student satisfaction with LMS: Content Completeness, Content Currency, Easy to Navigate, Easy to Access, and Course Staff Responsiveness.

Ramadania (2021) investigates students' perceptions of LMS used in online English learning during the COVID-19 pandemic. The study focused on popular LMS platforms like Google Classroom, Edmodo, Schoology, and Moodle. A quantitative survey was conducted with 125 respondents mainly from the Jabodetabek area. The findings revealed that students had a positive experience using LMS, as it facilitated their English learning through features such as assignment submission, quizzes, feedback, and communication forums. The study provided valuable insights into students' satisfaction with LMS platforms in the online learning context.

The research of Yulyanty and Togar (2021) aimed to analyze the factors influencing student satisfaction with the LMS and the extent of their impact. The study investigated the direct influence of system quality, information quality, service quality, and perceived ease of use on user satisfaction, as well as the indirect influence of system use on user satisfaction. The sample comprised 99 undergraduate students majoring in Information Systems enrolled in an online learning program at XYZ University. Regression analysis using the Partial Least Squares (PLS) method was conducted. The results revealed that the indirect effect through system use was not significant. However, perceived ease of use and system quality were found to significantly influence student satisfaction. Notably, perceived ease of use emerged as the most influential factor affecting student satisfaction with the LMS as a medium for online learning.

Ajijola et al. (2021) examined the perception of LMS among distance learners in South-West Nigeria, focusing on gender and field of study. Data was collected using a questionnaire and analyzed using descriptive and inferential statistics. The findings indicated significant differences between male and female learners in their perceived usefulness and ease of use of LMS, with males having a more positive perception. However, no significant differences were found among learners from different fields of study.

G and Wijewardana (2016) examined the attitudes of undergraduate students towards the use of LMS in Sri Lankan universities, considering the impact of perceived usefulness and perceived ease of use. The widespread acceptance of LMS in e-learning has revolutionized education, providing alternative learning methods, improved communication, and time-saving features. The research surveyed 120 undergraduates from Rajarata University of Sri Lanka, selected through purposive sampling. The results demonstrated that perceived usefulness and perceived ease of use significantly influence students' attitudes towards LMS usage, which are predominantly positive.

The existing literature indicates a significant impact of Learning LMS on student learning satisfaction. Among the various features of LMS, ease of use emerges as the most influential factor affecting student satisfaction with their learning experience. Several studies consistently reported that the utilization of LMS has led to enhanced ease and convenience in online learning. However, it is important to note that the research also acknowledges certain challenges associated with the use of LMS.

Araka et al. (2021) investigated the utilization of LMS features in promoting Self-Regulated Learning (SRL), a survey was conducted among university students in Kenya. The survey findings indicate that students underutilize the features of LMS for SRL. Qualitative results reveal several challenges that hinder active participation in online learning, including a lack of personalized feedback, inadequate instructor guidance, limited interaction with instructors and peers, and a dearth of automation tools.

The study of Alenezi (2018) aimed to identify barriers to the adoption of LMSs, in Saudi Arabian universities. LMSs are popular in educational institutions for their ability to enhance pedagogy and facilitate collaboration. The study surveyed 150 students from three universities in Saudi Arabia. The findings revealed several barriers to the use of LMSs, including insufficient technical support from universities, negative attitudes towards technology, and inadequate training on LMS platforms. Additional minor barriers included limited Internet access and networking, insufficient infrastructure to support LMS implementation, lack of necessary hardware and software, and difficulties related to English language proficiency.

The use of the LMS as a tool in online learning makes the learning and teaching process easier to students. Li et al. (2016) said that learners who are more satisfied with the quality of teaching materials, assessment strategies, and workload are more satisfied with the overall learning experience. Similarly, students who are satisfied in the use of the learning guides as well as the presence of a teacher increases student learning satisfaction.

Learning management system and academic performance. The study of Dzulkaman and Ali (2016) investigated the impact of LMS on students' academic performance. The findings from a questionnaire completed by 20 respondents at a Malaysian university suggested that the effectiveness of the LMS system and students' motivation significantly correlate with their academic success. It emphasized the importance of instructors playing an active role in motivating students to utilize the LMS through innovative and creative means.

Ahmed and Mesonovich (2019) explores the effectiveness of McGraw Hill Education's Connect platform in improving student grades in a pre-calculus course at a university in a Gulf Cooperation Council (GCC) country. It compares the grades of students who used Connect for online assignments with those who followed a traditional format. The study found that using Connect has a positive impact on student grades, as evidenced by statistical analysis. This research highlighted the importance of exploring different LMS, like those offered by publishing companies, in improving student performance.

Mohammed (2021) examined the impact of using a LMS on the academic performance of secondary school students in Bauchi State, specifically in the subject of Financial Accounting (FA). A quasi-experimental design was employed, and 240 students were selected using purposive sampling techniques. The research questions were analyzed using mean, standard deviation, and t-tests. The findings revealed a significant difference in academic achievement between students taught FA using the LMS tool compared to those taught through conventional methods. It was concluded that the use of LMS is effective in improving students' academic performance in FA.

Oguguo et al. (2020) study examined the impact of using a LMS, specifically Moodle, on students' performance in an educational measurement and evaluation course. The research utilized a non-equivalent group quasi-experimental design with undergraduate students from Imo State University, Nigeria. A sample of 232 students, comprising both males and females, is purposively selected. Data is collected using the "Measurement and Evaluation Achievement Test instrument, which demonstrated good reliability. The data is analyzed using descriptive statistics and analysis of covariance. The findings revealed that students taught using Moodle outperform those exposed to the CAI4ME Package. Additionally, female students performed better overall, although male students showed a higher gain score.

The literature review on LMS identified several gaps and overlaps in existing research regarding their impact on student satisfaction and academic performance. The gaps include limited exploration of challenges hindering active participation in online learning and insufficient attention given to barriers faced by students in using LMS effectively. The study aims to address these gaps and confirm the overlaps found in the literature. Additionally, the review highlighted the significance of LMS features, service quality, information quality, and ease of use in influencing student satisfaction. The study also seeks to validate the relationships between these factors and investigate the impact of LMS platforms used in PSHS on student grades and academic performance. In general, the present research aims to provide a comprehensive understanding of LMS usage and its implications to student learning satisfaction and academic performance.

Internal determinants. Brown (2007) defined internal factors as those which come from “inside” the individual or factors that involve the learners′ ability to acquire learning like study habits, attitude, motivation, and personal practice. The internal factor in this study includes gender, academic self-concept, academic motivation, academic performance, interest to learn and mental well-being.

Gender. Gender is an internal factor in learning that refers to the biological and psychological characteristics that define an individual (Faap, n.d.). In this study, the gender is classified as either male or female. Gender can influence the ways in which individuals learn, such as their cognitive abilities, learning styles, and interests as well as their physical health, mental health, behavior, and social interactions. Sherwin (2003) asserted that male and female learners have different cognitive abilities. Females are better at verbal, perceptual, and motor skills. Males excel at memory and mathematical skills. These differences of learning skills between male and females may affect their learning satisfaction during online learning.

Research has shown that males and females may have different learning styles and preferences. Males may prefer more competitive and individualistic learning environments, while females may prefer more collaborative and interactive learning environments. These preferences can influence the types of online learning activities and assignments that students find engaging and satisfying. Studies showed differing outcomes with gender in relation to learning satisfaction. The study of Dang et al. (2016) showed that gender is correlated to learning satisfaction. Moreover, there is a perception that gender may influence student satisfaction with online learning. For example, older female students may face unique challenges in online learning due to gender-based discrimination but maybe mature enough to overcome such challenges than males of the same age.

Gender and student learning satisfaction. The study of González-Gómez et al. (2012) explored the gender differences in student learning skills and their impact in the classroom. The study also investigates whether gender differences exist in e-learning, as the roles of students and teachers shift in this context. The main finding suggested that female students exhibited higher satisfaction levels than male students when it comes to the e-learning subjects analyzed. Additionally, the study revealed that female students placed greater importance on learning planning and having multiple means of contacting the teacher.

The approaches in learning of the male and female students of their online subjects may be different. Hence, in the implementation of online learning, gender may also affect student satisfaction. In the study of Lowes et al. (2016), their findings showed that females were more active than males. However, it is puzzling to note that females who have lower final grades have been more active than males who had lower grades.

Korlat et al. (2021) reported that the perceived teacher support, intrinsic value, and learning engagement among girls were higher than the boys but differences in competence beliefs among the genders in their digital learning experiences was not significant. Similarly, the study of Yekefallah et al. (2021) showed that learning satisfaction is not significant with respect to the gender of learners.

The study of Yu and Deng (2022) investigated gender differences in e-learning outcomes globally, focusing on self-efficacy, satisfaction, motivation, attitude, and performance. Through a meta-analysis and systematic review, the study concluded that, in general, there are no significant gender differences in e-learning outcomes across most countries. However, specific exceptions were found, such as females outperforming males in Spain and the UK, and exhibiting more positive attitudes in Austria, India, and mixed countries (Chile and Spain). In the USA, females showed higher self-efficacy levels.

Mohamad et al. (2020) assessed the implementation of Online Distance Learning (ODL) that posed challenges for students, prompting them to provide feedback after three months of online learning. This study aimed to examine whether there was gender-based differences in students' satisfaction and intention to continue with ODL. The results indicated that there was no significant difference in satisfaction and intention to continue ODL between male and female students. Additionally, the study identified slow internet coverage as the primary challenge faced by students in ODL.

Gender and academic performance. Wrigley-Asante et al. (2023) compared the academic performance of males and females in STEM subjects at the high school and university levels. It investigated the factors contributing to gender differences in academic performance at these two levels. The findings revealed that males performed better than females in high school, but the academic performance of females improved relative to males at the university level. Gender stereotypes played a significant role in the high school differences, while teaching methodologies, motivation, parental support, and advocacy campaigns for women's empowerment contributed to improved performance among females in college. In contrast, males' engagement in extracurricular activities and economic ventures, influenced by socioeconomic factors and gender ideologies, impact their academic performance at the university level.

The study of Tsaousis and Alghamdi (2022) aimed to achieve three objectives, (1) examining the dimensions of General Academic Ability (GAA) at the subscale level, (2) exploring the measurement invariance across gender using advanced techniques, and (3) investigating gender differences in the facets of GAA. The results revealed a hierarchical model with a higher-order factor GAA and lower-order factors (verbal ability, quantitative ability, scholastic aptitude, and Grade Point Average (GPA) that fit the data well. The measurement invariance analysis indicated configural and metric invariance, with partial scalar invariance. Gender differences were observed in the Verbal and GPA domains, with females scoring higher. However, differences in the Scholastic aptitude domain were less reliable due to non-invariant items. No significant gender differences were found in the Quantitative domain, but females scored higher than males in the higher-order factor GAA.

Ghazvini and Khajehpour (2011) examined gender differences in cognitive-motivational variables and academic performance in Literature and Mathematics subjects among high school students. The sample includes 363 students from different academic years. The results indicate that girls demonstrated an internal locus of control, utilized various learning strategies more extensively, and achieved higher grades in Literature. Boys, on the other hand, use different learning strategies and performed better in Mathematics. No gender differences were found in external locus of control, academic self-concept, and study aids and test strategies. Overall, the study suggested that boys and girls have distinct cognitive-motivational approaches in the academic environment, with girls displaying a more adaptive learning style.

Parajuli and Thapa (2017) evaluated gender differences in academic performance among students in Lekhnath Municipality, Kaski, Nepal. The sample included 240 students who passed the grade eight district level standard exam in 2016 and were currently in grade nine in public and private schools. Data on student characteristics, parental information, student behavior and perceptions, family environment, and school environment were collected through a structured questionnaire administered to students, parents, and teachers.

The findings indicated significant gender differences in academic performance, with female students performing better than their male counterparts. Most of the students achieved high grades, with private schools showing superior performance compared to public schools. Moreover, students attending private schools displayed better task completion, attendance, and assertiveness.

The literature review on gender and learning satisfaction reveals mixed findings. While some studies suggest that female students are more satisfied with e-learning subjects, the specific contributing factors are unclear. Female students prioritize learning planning and contacting teachers, but it is uncertain if male students share these preferences. Interestingly, female students with lower grades are more active, but the reason behind this is unknown. Some studies report no significant gender differences in e-learning outcomes, without specifying the factors considered. Female students perceive higher teacher support, intrinsic value, and learning engagement, but there is no significant difference in competence beliefs. There are knowledge gaps in understanding factors behind improved academic performance of females in university compared to high school, explaining the impact of non-invariant items on gender differences in the scholastic aptitude domain, and exploring gender differences beyond certain domains. Socio-cultural factors and educational practices' influence on gender differences are also underexplored.

However, the literature confirms that females score higher in Verbal and GPA domains and shows no significant gender differences in the Quantitative domain. It supports the notion that girls have an internal locus of control, employ various learning strategies, and excel in subjects like Literature, while boys perform better in Mathematics. The present study aims to address these gaps in the literature.

Academic performance (AP). Academic performance refers to the evaluation of a student's accomplishments upon completion of a course or subject within an educational institution. It encompasses the assessment of students' learning in diverse academic areas through formative and summative evaluations. Academic performance represents the culmination of students' endeavors in achieving specific educational objectives (Roy et al., 2023).

Academic performance and student learning satisfaction. Numerous research shows that student satisfaction has an impact on student academic performance. Dhaqane (2016) reported a strong Pearson correlation between the student satisfaction and their academic performance. The study also showed that both academic performance and student retention are strongly influenced by satisfaction among the freshmen and third year students of Benadir University in Mogadishu, Somalia.

Aggarwa (2021) studied the influence of online courses on the student satisfaction and performance during the pandemic times and found out that the four independent factors used in the study (quality of instructor, course design, prompt feedback, and expectation of students) were crucial towards attaining a high satisfaction level and performance level in online classes as they positively were found to have strongly influenced the students’ satisfaction and performance.

The study by Kerzic et al. (2021) on a sample of higher education students from 10 countries across 4 continents through an online survey showed that their satisfaction with e-learning strongly influenced the students' performance. Banahene et al. (2018) reported in their study among 600 students selected from 6 private universities in Ghana that student learning attitudes towards learning have positive and statistically significant influence on students' academic performance and satisfaction.

Keržič et al. (2021) examined the impact of the COVID-19 pandemic on higher education and the rise of e-learning. The research explored the factors influencing students' perception of their academic performance during the transition to online learning. A sample of 10,092 students from 10 countries across 4 continents participated in an online survey. The findings highlighted the importance of service quality, active teacher involvement, and overall system quality in determining the quality of e-learning. Students' digital competencies and online interactions with peers and teachers also contribute to their perception of academic performance. The study revealed that students' satisfaction with e-learning plays a crucial role in mediating the relationship between e-learning quality and academic performance.

Banahene et al. (2018) evaluated the impact of HEdPERF (Higher Education Performance) on students' satisfaction and academic performance in Ghanaian private universities. It also investigated the mediating role of students' attitude towards learning. The research utilized a questionnaire and applied Structural Equation Model for data analysis. The findings indicated that HEdPERF has a positive and significant relationship with students' satisfaction, attitude towards learning, and academic performance. Furthermore, students' attitude towards learning partially mediated the relationship between HEdPERF and students' satisfaction as well as academic performance.

While some literature suggests a direct link between student learning satisfaction and academic performance, there are also studies that present contrasting perspectives. These studies explore the complex relationship between satisfaction and performance, acknowledging various factors that can influence academic outcomes. Factors such as student motivation, engagement, teaching quality, and external circumstances may interact with satisfaction to impact academic performance.

The study by Zamri et al. (2021) which aimed to understand what affects student satisfaction and academic performance in an open and distance learning (ODL) environment using online survey questionnaires found out that the course design is the main indicator that affected student satisfaction in ODL. Their findings showed student satisfaction had no effect on their academic performance.

A study conducted by Khan and Iqbal (2016) revealed significant findings regarding student satisfaction in various interaction aspects within the learning environment. Most students expressed overall satisfaction with learner-learner interaction, followed by learner-content interaction and learner-technology interaction, as well as learner-instructor interaction. Notably, learner-content interaction and learner-instructor interaction emerged as significant predictors of general satisfaction, whereas learner-learner interaction and learner-technology interaction did not significantly predict general satisfaction. Surprisingly, no significant correlation was found between students' satisfaction and their academic achievement.

The literature reviewed investigates the connection between learning satisfaction and academic performance among students. In general, the findings reveal a positive correlation, indicating that greater levels of learning satisfaction are linked to improved academic performance. However, it is important to acknowledge that some studies have reported no significant influence of student satisfaction on academic performance. Therefore, the current study aims to further explore this finding and investigate the potential factors contributing to this relationship.

Academic self-concept (ASC). Self-concept pertains to an individual's capacity to hold a positive perception of themselves and their abilities. In an academic context, academic self-concept specifically relates to one's perception of their learning capabilities. It can vary across different academic disciplines and may be influenced by previous academic achievements. Students who possess high levels of academic self-concept are those who believe in their ability to excel in their academic endeavors (Marsh & Shavelson, 1985).

The augmentation of ASC has been observed to correspond with subsequent improvements in academic achievement as well as other favorable educational outcomes. The findings of Marsh and Martin (2011) validated that self-concept is not only a significant outcome variable on its own but also served as a pivotal factor influencing various other desirable educational outcomes. The implications of ASC in the learning satisfaction of students were discussed from the literature cited.

Academic self-concept and student learning satisfaction. The study by Doménech-Betoret et al. (2017) explored the relationship between academic self-efficacy, students' expectancy-value beliefs, teaching process satisfaction, and academic achievement. The main aimed is to uncover the motivational processes that underlie the impact of academic self-efficacy on students' achievement and satisfaction. The study utilized structural equation modeling for data analysis. The results demonstrated that students' expectancy-value beliefs, such as subject value, process expectancy, achievement expectancy, and cost expectancy, act as mediators between academic self-efficacy and the outcomes of achievement and satisfaction. These findings provided empirical evidence and enhanced our understanding of the mechanisms that mediate the connections between self-efficacy, achievement, and course satisfaction.

Two studies were conducted to explore the relationships between academic self-concept, perceptions of the learning environment, engagement, and various learning outcomes among university students. Study 1 utilized a cross-sectional design and found that engagement mediated the effects of academic self-concept and perceptions of the learning environment on generic skills development and learning satisfaction. It also revealed direct relationships between academic self-concept and academic achievement as well as between perceptions of the learning environment and learning satisfaction. Study 2, which followed a longitudinal design with three data collection waves, confirmed the findings of Study 1 and demonstrated a reciprocal effects model, indicating that prior academic achievement predicted subsequent self-concept, which, in turn, influenced future achievement even when accounting for prior achievement (Guo et al., 2021).

The study by Hassan et al. (2021) investigated academic self-perceptions and course satisfaction among university students during virtual classes. The study surveyed undergraduate and postgraduate Saudi students who experienced online learning during the COVID-19 pandemic. Results showed that positive academic self-perceptions were found to strongly influence course satisfaction.

The influence of academic self-concept and social presence on students' learning achievement and satisfaction in both face-to-face and online versions of a digital design course was the aim of Zhan and Mei (2013) in their research. A total of 257 undergraduate students participated, with half assigned to the FTF group and the other half to the online group. The results indicated that both academic self-concept and social presence significantly impact students' learning achievement and satisfaction, although social presence has a stronger effect in the online environment. Face-to-face students reported higher social presence, while no significant difference was found in academic self-concept between the two groups. These findings highlight the importance of considering students' self-concept and social presence in designing effective instructional approaches for both face-to-face and online learning environments.

Academic self-concept and academic performance. The study by Ajmal and Rafique (2018) showed a strong correlation between academic self-concept and the academic performance of online learners. Thus, they recommended that there must be proper workshop sessions for students so they can enhance their self-concept as well as understand their hidden potential and use their abilities to be better in their academics.

Korantwi-Barimah (2017) studied the correlation between academic self-concept, motivation, and academic performance of Sunyani Technical University students. They reported significant relationships between academic self-concept, motivation, and academic performance of students. Differences in gender were also studied in relation to these variables and the result of the study revealed that the level of motivation of female students was higher than the male counterparts.

Marsh and Martin (2011) reviewed other research using meta-analysis to evaluate the relationship between academic self-concept and academic performance. Their results showed that an increase in academic self-concept also increases academic performance. Academic self-concept plays a central core in affecting other desirable educational outcomes.

Singh (2015) conducted a study on the interaction of student study habits and self-concept on Mathematics academic performance using ANOVA. Results revealed that the correlation between the self-concept and the academic performance of the students in mathematics was significant. A significant correlation was also found between academic performance in mathematics and the combined effect of study habits and self-concept.

Hayat et al. (2020) study explored the role of metacognitive learning strategies and learning-related emotions as mediators in the relationship between academic self-efficacy and academic performance among medical students. Using structural equation modeling, the results demonstrated that students' self-efficacy significantly influenced their learning-related emotions and metacognitive learning strategies, which subsequently impacted their academic performance.

Cruz and Lumahan (2022) study examined the impact of academic self-concept on academic performance in the context of online learning. By employing a descriptive correlational design, the statistical analysis revealed that academic self-concept significantly influenced learners' academic performance. The findings suggested that learners' beliefs about their academic abilities play a crucial role in their educational achievements, particularly when they proactively engage in initiatives and exert effort to enhance their learning capacity.

The literature cited in the discussion identifies several gaps in the understanding of learning satisfaction and self-concept. These include the lack of consideration for the role of generic skills development in mediating the relationship between academic self-concept, perceptions of the learning environment, and learning satisfaction. The mechanisms through which prior academic achievement affects self-concept and subsequent achievement are also not explained. The relationship between motivation, academic performance, and academic self-concept needs further exploration. The correlation between self-concept and academic performance in mathematics, as well as its potential variations in other subjects, requires more elaboration. Additionally, the specific educational outcomes influenced by academic self-concept beyond academic performance are not addressed.

However, there are also areas of overlap between studies on academic performance and learning satisfaction. Both studies acknowledge the mediating role of academic self-concept between prior and future achievement. They also recognize the impact of perceptions of the learning environment on learning satisfaction. Furthermore, both studies highlight the significance of academic self-concept in influencing achievement and learning satisfaction. The importance of social presence in shaping learning achievement and satisfaction is emphasized in both studies, with one study noting a stronger effect in online environments. Lastly, they both emphasize the significance of self-concept in influencing educational outcomes, although one study lacks specific details in this regard. The present study aims to address the identified gaps and further investigate the areas of overlap between these two research areas.

Academic motivation (AM). Academic motivation encompasses the driving factors behind behaviors that impact academic performance and achievement. These factors include the level of effort students invest, their ability to manage their workload effectively, the pursuits they choose to engage in, and their perseverance in the face of challenges (Usher & Morris, 2012).

Academic motivation and student learning satisfaction. The findings of Hettiarachchi et al. (2021) using Structural Equation Modeling analysis demonstrated that perceived learner motivation, perceived challenges of e-learning, and interaction were significant factors influencing students' satisfaction with their online learning experience. Among these variables, learner motivation had the most pronounced impact on student satisfaction, highlighting the critical role of self-regulated learning, characterized by motivation, in online learning environments.

Todorova and Karamanska (2015) explored the evolving nature of higher education in the context of the information society, focusing on equipping students with the skills to navigate the unpredictable flow of knowledge. The study conducted at Utah Council of Teachers of Mathematics (UCTM), an engineering university in Sofia, examines motivation and satisfaction in an active e-learning environment. It discusses the integration of e-learning in academic practices and evaluates students' perceptions of the university's readiness for its implementation. The study also highlighted the importance of students' satisfaction with learning as a key factor in their motivation and overall learning outcomes.

Wach et al. (2016) investigated the determinants of students' satisfaction with their academic studies. It examined the predictive power of various factors, including demographic variables, personality traits, cognitive and achievement-related variables, and motivational constructs. The study analyzed data from a sample of university students using structural equation modeling. The results highlighted the significance of personality and motivational variables, with neuroticism playing a role in predicting satisfaction with academic studies. The initial motivation for choosing a major is also found to be correlated with satisfaction in certain dimensions. However, the predictive value of cognitive and achievement-related variables is relatively low, with academic achievement showing a relationship with satisfaction in specific aspects of the academic program.

Poteliūnienė et al. (2022) examined the changes in academic motivation and satisfaction among pre-service physical education (PE) teachers during their study period. It explored the relationship between autonomous and controlled academic motivation and student satisfaction with academic studies. Questionnaire surveys were conducted at four different time points in four Lithuanian universities. The results indicated that both academic motivation and satisfaction with studies undergo changes over time. Autonomous and controlled academic motivation are similarly related to different aspects of student satisfaction. These findings enhanced our understanding of how students' academic motivation evolves and their perception of the academic environment as reflected in their satisfaction with their studies.

Academic motivation and academic performance. Dogan (2015) defined academic motivation as a goal of students to be better in their academic performance. He reported in his study that, academic motivation, cognitive engagement, and academic self-efficacy predict the academic performance of the students. In addition, the findings of the study showed that the sense of self-capability, motivations of the students, and the sense of purpose for their learning, are significant factors that influence their academic performance. Emotional and behavioral engagements do not predict academic performance success.

Akomolafe et al. (2013) reported that the predictors of the academic performance of the students are academic self-efficacy, academic motivation, and academic self-concept. Academic self-efficacy had the most significant influence on academic performance and followed by academic self-concept and academic motivation. The enrichment of academic self-efficacy, academic motivation, and academic self-concept using appropriate counseling schemes is necessary for academic performance success.

Ilo and Onyeyesi (2021) conducted research on 405 private and public secondary school students from both in Enugu-East Local Government Area. Respondents took the Raven Standard Progressive Matrices and Academic Motivation Scale modified to measure the Intelligence quotient and Academic motivation respectively among these secondary school students. Results showed that academic motivation influenced the students' learning success and academic performance.

In the study of Amrai et al. (2011) among 252 students to determine the correlation between academic motivation and academic performance showed a positive and significant relationship between academic motivation and academic performance. Furthermore, factors related to motivation like task, effort, competition, and social concern were found to have significant correlation with their academic performance.

The academic success or failure of a student is influenced by various factors such as self-esteem, academic engagement, and motivation. Acosta-Gonzaga (2023) research explored the relationship of the said factors, a quantitative study was conducted involving 243 university students. The study analyzed how self-esteem and motivation affect academic engagement, which ultimately reflects in students' academic performance. The findings indicated that self-esteem has effects on emotional and behavioral disengagement. In contrast, motivation exerts a stronger influence on academic engagement, with metacognitive engagement emerging as a significant predictor of academic performance.

The cited literature identified several gaps and overlaps in the research on students' satisfaction with online learning and its relationship with academic motivation and performance. The specific mechanisms underlying the influence of perceived learner motivation, e-learning challenges, and interaction on satisfaction are not explained. The integration of e-learning in academic practices and students' perceptions of the school's readiness for its implementation are not elaborated. The relationship between satisfaction and motivation, as well as the role of personality and motivational variables, needs further exploration. The predictive value of cognitive and achievement-related variables on satisfaction is relatively low, and their specific impact is not well-defined. Changes in academic motivation and satisfaction over time lack detailed analysis.

The study also fails to explain how academic motivation, cognitive engagement, and academic self-efficacy predict academic performance. Factors influencing self-capability, motivation, and sense of purpose for learning are not thoroughly analyzed in relation to academic performance. The relationship between academic self-concept, academic motivation, and performance is mentioned but lacks elaboration. The influence of academic motivation on learning success and performance requires further clarification. The correlations between motivation factors and academic performance are briefly mentioned but not extensively discussed. The effects of self-esteem on emotional and behavioral disengagement and the relationship between motivation and academic engagement are briefly mentioned without thorough examination.

Despite the gaps, there are overlaps between the studies. Some studies recognize academic motivation as a significant predictor of performance. The influence of academic self-efficacy on performance is mentioned. The significance of academic self-concept and its relationship with motivation and performance is also mentioned. The positive relationship between academic motivation and performance is highlighted. Factors related to motivation, such as task, effort, competition, and social concern, are recognized as important for academic performance. The impact of motivation on academic engagement is mentioned, with one study specifically highlighting the importance of metacognitive engagement. Furthermore, it was cited the importance of satisfaction with studies and motivation in influencing overall learning outcomes. The role of self-regulated learning and its connection to autonomous and controlled academic motivation is emphasized. The impact of the academic environment, including the challenges of e-learning and interaction, on satisfaction is recognized. The connection between initial motivation for choosing a major and satisfaction suggests a link between academic motivation and satisfaction with specific aspects of the academic program. The findings contribute to understanding how academic motivation evolves and how students perceive the academic environment, as reflected in their satisfaction with studies.

Interest to learn (IL). Interest to learn is a motivational attribute which exudes intrinsic feeling-related and value-related emotions. Interest to learn involves the giving attention to the depth of text comprehension, to the use of learning approaches, and to the emotional experience while going through the learning process (Shiefele, 1997).

Interest is a powerful motivator that influences students' academic success and career choices. It encompasses both a psychological state of attention and an enduring predisposition to engage with a specific subject. This summary highlighted the four-phase model of interest development, which guides interventions to promote and capitalize on students' interests. Effective strategies include creating engaging learning environments, incorporating topics that align with students' existing interests, implementing problem-based learning approaches, and emphasizing the practical value of the subject matter. By promoting interest, educators can enhance student engagement and motivation, leading to more fulfilling and successful learning experiences (Harackiewicz et al., 2016).

Interest to learn and student learning satisfaction. The study of Hsu (2017) aimed to explore the relationship between students' satisfaction and learning interest when utilizing a web-based learning platform. The participants consisted of students from two departments at a tertiary institution in central Taiwan, with ages ranging from 19 to 24 years old. A total of 302 participants completed an online questionnaire, and data analysis was conducted using descriptive statistics, Pearson correlation, and ANOVA. The findings revealed a positive and significant correlation between students' satisfaction and learning interest when using the web-based learning platform.

Interests have a significant impact on our academic and career decisions. A comprehensive study conducted by Harackiewicz et al., (2016b) and her colleagues Huang (2021) explored the influencing factors of learning satisfaction in blended learning. Three dimensions were proposed: perceived usefulness, perceived ease of use, and learning motivation. It studied how these variables affect students' learning satisfaction. The questionnaire survey method is applied in this research to analyze the relationship between the variables and verify the hypothesis based on the collected 173 valid questionnaires. The partial least square method structural equation model was used to carry out structural equation modeling to study the relationship between latent variables. It explains that the perceived ease of use affects the perceived usefulness. Perceived usefulness and perceived ease of use have a positive impact on learning motivation. Learning motivation has a positive impact on learning satisfaction. Perceived usefulness as an intermediary factor of perceived ease of use has an indirect impact on learning motivation.

Results revealed that students' interest in an introductory psychology course during their freshman year strongly influenced their likelihood of pursuing additional psychology classes and majoring in the subject. Surprisingly, interest in the course was a more accurate predictor of future choices than the students' grades. Research consistently demonstrates that interest surpasses prior achievement or demographic factors as a powerful determinant of future decisions. This study proved that interest to learn enhances learning satisfaction of students.

Interest to learn and academic performance. A study conducted by Mutinda and Mugambi (2020) utilized correlation and t-test at 0.05 level of significance to test the correlation between interest to learn and academic performance among students in a secondary school. The results showed that the relationship between the students' interest to learn and academic performance was significantly positive. Furthermore, it was also found that there were significant gender differences for interest to learn in favor of boys.

Arhin and Yanney (2020) conducted a study on the correlation between academic performance and interest in Mathematics. The result showed low performance in Mathematics because most students do not have an interest in the subject.

Wong and Wong (2019) conducted a descriptive statistical analysis research on the correlation between interest and Mathematics performance. The study found that the relationship between interest and mathematics performance was significant only among students with lower performance in mathematics. The study recommended the importance of fostering interest among students who struggle with Mathematics.

Similarly, Arhin and Yanney (2020) conducted a descriptive survey on secondary school students at Agogo State College, focusing on the relationship between student interest in mathematics and academic performance. The study involved 200 students selected through proportionate stratified sampling out of a target population of 670. Data was collected using self-prepared questionnaires and document review. The findings indicated that while most students lacked interest in mathematics, there was a strong positive relationship between their interest in studying Mathematics and their academic performance. These findings suggest the significance of cultivating interest in mathematics to improve academic outcomes.

Mappadang et al. (2022) focused on the factors influencing the academic performance of undergraduate students in Indonesia. The study examined the role of academic interest, learning attitude, and learning quality, as well as controlled variables. The research used a cross-sectional survey design with 872 samples obtained through disproportionate random sampling. The findings indicated that academic interest significantly impacts academic performance, while learning attitude and learning quality do not show significant contributions. Students with high academic interest are more likely to achieve better academic performance.

Sauer (2012) research project examined the impact of student interest and instructor effectiveness on student performance. The study involved two middle school students, and data was collected through questionnaires, student work samples, and observations. The findings indicated that student interest and the quality of the student-instructor relationship were influential factors in achieving successful academic performance.

According to Ezike (2018), there is a significant relationship between students' academic interest and their achievement in Senior Secondary School Chemistry. This highlights the importance of interest in academic success. Interest influences students' willingness to exert effort and engage in learning activities. It is closely tied to their positive reactions towards specific aspects of the environment. Kpolovie et al. (2014) said that teachers can harness situational interest in the classroom to motivate students, including those who may be disengaged or unmotivated, leading to better learning outcomes.

The literature review examines the relationship between interest to learn, learning satisfaction and academic performance, focusing on the gaps and overlaps in previous findings. Regarding the relationship between interest and learning satisfaction, there is evidence of a positive correlation, particularly when using web-based learning platforms. However, causality between the two variables has not been established, and the lack of specific information about the study's population limits generalizability. The overlap between interest and satisfaction suggests that both factors contribute to a positive learning experience. It emphasizes the importance of fostering interest to enhance overall satisfaction and engagement in the learning process. Further research is needed to establish causality and generalizability.

Regarding the relationship between interest and academic performance, the findings indicate a significant positive correlation, particularly for students with lower performance in the subject. This highlights the importance of cultivating interest in specific subjects, such as Chemistry, to improve academic outcomes. Additionally, the quality of the student-instructor relationship was found to influence academic performance, while learning attitude and quality showed limited contributions.

In summary, the literature emphasized the positive relationship between interest and academic performance and highlighted the significance of interest in learning. It also underscored the importance of fostering interest in specific subjects and maintaining positive student-instructor relationships. The present study aimed to further explore causality and the specific nature of the relationship between interest and academic performance.

Mental well-being (MW). Transition period in an adolescent is characterized by various challenges and individual struggles which is due to their being adolescent or caused by stressors.

The mental well-being of students is affected because of the changes they encounter. Peterson (2021), in her article, defines mental well-being as the level of existential struggle in various areas of life (such as in relationships, work, play, and more). Mental health challenges have a pervasive impact on various aspects of student life. One such challenge is low self-esteem, which often results in diminished motivation and a lack of confidence when it comes to accomplishing tasks or taking tests. Additionally, anxiety can significantly hinder students' ability to study effectively or attend classes regularly. Furthermore, depression can lead to reduced focus and concentration, making it challenging for students to stay engaged and complete their work within deadlines (Understanding the Impact of Mental Health on Academic Performance | Independent School Management | Advancing School Leadership—Enriching the Student Experience, n.d.).

Park (2016) said that students frequently encounter undesirable negative emotions because of inadequate emotional support during their interactions with online learning content. In his report, Swerdloff (2016) underscored the significant impact of students' emotional state on their attitude and academic performance. Unfortunately, the emotional well-being of students is frequently overlooked and disregarded in conventional educational environments. Prolonged exposure to screens, tablets, and smart devices has resulted in an escalation of stress and anxiety levels. The mental health strain caused by telecommunication can compound the existing stressors associated with e-learning, eventually leading to exhaustion and burnout (Mheidly et al., 2020).

Park et al. (2020) conducted a study on understanding mental well-being challenges to comprehend how university students pursue and obtain support to keep their mental well-being healthy while struggling through frequent life events in their process of growing as adults. Results showed that there are three key factors namely: (1) the necessity to secure help that aligns with the apparent severity of the problem, (2) the necessity for support givers to continuously rebuild relationships, and (3) overcome tensions between the necessity to disclose and the stress related with disclosure. The study also recognized time, audience, and disclosure as the three important factors that maintain healthy mental well-being.

A study conducted by Rao and Rao (2021) used a survey-based approach along to identify the main cause of stressors from a set of high school students in the Midwest United States during the COVID-19 pandemic. They reported that indicators such as gender, homework and school time, mental health issues, and therapy did not have a significant impact on the decline of mental health among students. Student feedback analysis showed that there are three frequent themes: heightened stress related to homework, social isolation or absence of social interaction, and absence of support for mental well-being.

Schwartz et al. (2021) in their study revealed that return-to-school experiences in the first few weeks, pandemic-related stresses, and behavior, affected their cognitive functioning. Students reported moderate and equal concerns for their health, family, confinement, and in maintaining social contact. The levels of stress of students were also above the dangerous threshold, especially for female and older adolescents (15-18 years old) in general in comparison to younger males. A significant positive relationship was found between self-reported behavioral concerns and stress arousal. Self-reported behavioral issues included conduct problems, negative effect, and cognitive/inattention while stress-causing issues involved problems, sleep, and hypervigilance.

Mental well-being and student learning satisfaction. The study by Franzen et al. (2021) showed that depression, anxiety, and stress were strongly associated with lower academic satisfaction scores while psychological well-being was associated with higher learning satisfaction. Furthermore, anxiety and stress were found to be high among the female students but not depression or psychological well-being. Lastly, age (more mature learners) was related to better psychological well-being.

Ionescu et al. (2023) investigated the satisfaction of university students with online learning and its relationship with depression, anxiety, insomnia, and online usage. The survey involved 463 medical students, with a focus on estimating online learning satisfaction and exploring secondary outcomes. The results indicated that depression, anxiety, and insomnia were negatively associated with overall satisfaction with e-learning. Additionally, higher levels of online usage correlated with greater satisfaction. Significant differences were observed in students' perceptions of interactivity, with the opportunity to learn through chat-box impacting overall satisfaction. Positive aspects such as convenience and cost-effectiveness were related to satisfaction, while higher psychopathology scores were linked to lower satisfaction. Spending more hours online contributed positively to satisfaction levels.

In June 2020, a survey was conducted by Tran et al. (2022) among university students, with a response rate of 15%. The study revealed that academic satisfaction had a stronger impact on mental health compared to COVID-19-related stress in relation to the learning experience. Lower academic satisfaction scores were associated with higher levels of stress, depression, and anxiety, while higher scores were linked to better psychological well-being. Female students reported higher levels of anxiety and stress, while age was associated with stress only.

Mental well-being and academic performance. Butt et al. (2021) confirmed that the outbreak of the 2019 pandemic has compelled students to transition to online classes, resulting in heightened stress levels and adverse effects on their academic performance.

Grøtan et al. (2019) examined the impact of mental distress on academic self-efficacy and study progress among Norwegian full-time students. Out of the 2,430 participants, 17% reported severe symptoms of psychological distress. It was found that students with severe mental distress were more likely to have low academic self-efficacy and experience delayed study progress compared to those with milder symptoms. Additionally, 27% of students with severe mental distress sought professional help, while 31% considered seeking help. The study highlighted the strong connection between mental distress, academic self-efficacy, and study progress.

Mental health issues are a significant concern among university students, impacting their well-being and academic success. The study of Abdullah et al. (2022)

focused on final-year students in the Faculty of Sports Science & Recreation at Universiti Teknologi Mara (UiTM). Results showed that most students reported high levels of mental well-being, with only a small percentage experiencing depression. There was a positive correlation between mental well-being and academic performance. However, some areas need attention to support students in addressing mental health challenges.

The study of Klapp et al. (2023) examined the well-being of 6th-grade students in Sweden and its relationship to academic achievement in compulsory school. Data from two cohorts (born in 1998 and 2004) were analyzed, considering factors such as cognitive ability, parental education, and gender. The results revealed a decline in well-being for the 2004 cohort, particularly in psychological and social dimensions. Girls also experienced lower well-being in these areas. Interestingly, higher levels of school-related stress were associated with better academic performance, while cognitive well-being positively correlated with academic achievement.

This systematic literature review conducted by Grabel (2017) explored the relationship between well-being, school, and academic achievement. Out of 300 initially identified studies, 5 were selected based on exclusion criteria. The selected studies suggested a positive correlation between emotional and psychological well-being and academic achievement. Students with higher levels of psychological and emotional well-being tend to achieve better academically. Factors such as engagement, self-esteem, organizational justice, interpersonal relationships with teachers, students' perception of school, and motives for attending school may influence the relationship between well-being and academic achievement.

The literature provides a comprehensive analysis of how the cited determinants affect student learning satisfaction and academic performance. It highlights the potential positive and negative effects that these determinants can have on these outcomes. However, to gain a more comprehensive understanding of their implications, it is essential to delve into the specific positive and negative determinants that influence learning satisfaction and academic performance. These factors may encompass aspects that contribute to students' enjoyment and engagement in online learning, as well as potential challenges or complaints they may encounter during the process. By examining these factors in detail, we can develop a deeper appreciation for the complex dynamics that shape students' experiences in online learning and their subsequent satisfaction and academic performance.

The cited literature identifies several gaps and overlaps in evaluating the relationship between mental well-being, learning satisfaction, and academic performance. Gaps include the absence of specific measures to assess mental well-being and learning satisfaction, lack of exploration of underlying factors or mechanisms, insufficient clarity on COVID-19-related stress and its impact, and inadequate definition or measurement of mental well-being. Additionally, there is a lack of examination of long-term effects of stress on academic performance which is not the main goal of the present study.

Overlaps include the positive correlation between mental well-being and academic performance, highlighting the importance of supporting students' mental health. Cognitive well-being is also positively associated with academic achievement, emphasizing the role of cognitive abilities. Factors such as engagement, self-esteem, organizational justice, interpersonal relationships, and school perception influence the relationship between well-being and academic achievement.

The study emphasizes the need to support students' mental health for enhanced educational outcomes. However, further research is necessary to understand underlying mechanisms and the long-term effects of stress. Addressing these factors can guide the development of interventions and support systems for promoting mental well-being and academic success. The present study aims to further identify the relationship between mental well-being, learning satisfaction and academic performance.

The existing literature examined various factors influencing student learning satisfaction in both traditional and online learning environments. The positive and negative effects of the determinants to learning satisfaction and on academic performance were discussed. Some of these studies were not conclusive, contradictions on the research findings also exist. Thus, to answer the gap and to further explore the impact of these determinants specifically in an online learning setting, this study was conducted. The determinants of the study were narrowed down into external (teacher related indicators, assessment related indicators, learning guide, learning management system) and internal factors (gender, academic motivation, academic self-concept, interest to learn and mental well-being) under investigation, the study aims to provide valuable insights into the determinants of learning satisfaction and academic performance in the context of online education.

Predictive Modelling

Over the past few years, there has been a growing interest among researchers in determining educational models as a tool to enhance the quality of education. Predictive models play a crucial role in forecasting educational outcomes, which can greatly contribute to improving the teacher's pedagogy and teaching styles as well as policies pertaining to education. While there have been numerous research studies focusing on predicting students' performance at the academic setting, there is a scarcity of research related to developing predictive models. Predictive modeling has evolved into an essential methodology for researchers, enabling significant advancements in comprehending intricate phenomena in education.

Predictive modeling is a statistical technique that utilizes machine learning and data mining to anticipate and forecast probable future outcomes, leveraging historical and current data. By analyzing existing and past data, predictive modeling generates a model that projects likely outcomes. This technique enables researchers, analysts, and data scientists to extract valuable insights and make informed predictions to drive decision-making and gain a competitive edge (Lawton et al., 2022).

It is important to consider that a predictive model is not static; it undergoes regular validation and revision to incorporate changes in the underlying data. In other words, it is not a one-time prediction. Predictive models make assumptions based on historical patterns and current circumstances, considering what has occurred in the past and what is happening at present (Ivanescu et al., 2015)**.**

In this study, the term "prediction" is employed to describe the process of estimating an event (online learning) or variable (External and Internal determinants) that has already taken place but remains unobserved or unevaluated. This concept encompasses the development of models, specifically the SLS model and AP model, which serve as predictive models. The primary objective of these models is to forecast the value of a response variable by utilizing measured predictor variables as input values.

Benefits and Challenges of Predictive Modelling

Predictive modelling is a valuable tool that effectively minimizes time, effort, and costs associated with forecasting educational outcomes. By incorporating various variables such as external and internal factors and learning conditions into mathematical calculations, predictive modelling provides more comprehensive insights at a relatively low cost (Ali, 2022).

Notably, predictive modelling finds extensive application in academic settings. Researchers and educators leverage predictive modelling to analyze historical data, identify patterns, and make predictions in various fields such as economics, social sciences, and education. The article of Brooks and Thompson (2017) serves a comprehensive exploration of the process, practice, and challenges involved in leveraging predictive modeling within the realms of data analysis and predictive analytics. Predictive modeling has evolved into an essential methodology for researchers, enabling significant advancements in comprehending intricate phenomena. By utilizing predictive modelling, academic researchers can identify determinants that may affect student learning satisfaction and academic performance. Knowing these predictive models (SLS and AP models) will eventually help the teachers to enhance their pedagogy and develop instructional materials based on the models. Similarly, administrators and policy makers improve resource allocation, and gain valuable insights to support evidence-based decision-making.

The case study of Smith et al. (n.d.) highlighted the growth of online courses in community colleges to increase student completion rates. However, the challenge lies in retaining and supporting online students for their success. To address this, higher education institutions employed learning analytics and predictive models. The case study focused on a community college that utilized these tools to identify at-risk students based on various key variables. This enabled proactive interventions and support to enhance student success in online learning. The article review of Asiah et al. (2019) emphasized that predictive models can guide the learning process, help students avoid poor scores, and assist instructors in forecasting course completion and student grades. To create effective predictive models, high-quality data, relevant variables, suitable methods, and robust models are essential.

The study of Sghir et al. (2022) examined the increasing use of Machine and Deep learning models in predicting academic outcomes through predictive modeling in Learning Analytics and Educational Data Mining. The review focused on recent research published between 2012 and 2022, exploring the predicted outcomes, learning features, and the predictive modeling process. The study served as a comprehensive reference for researchers, offering insights into the progress of predictive learning analytics. It also provides information to inform educational stakeholders and decision-makers about prospects and opportunities in this field.

In education, institutions can use student data and predictive analytics to monitor and improve their operations. By analyzing past records and feedback, faculty can enhance teaching methods and address challenging subjects. The study of Sghir et al. (2022) identified the following benefits in using predictive analytics also known as predictive modelling.

1. Predictive modeling techniques can help identify students who are at risk of academic difficulties or dropping out early in the educational journey. This enables timely interventions and support, increasing the chances of student success.
2. By analyzing student data, predictive models can provide insights into individual learning patterns, preferences, and needs. This allows educators to tailor instruction and educational resources to meet the specific requirements of each student, enhancing the learning experience.
3. Predictive modeling can help educational institutions identify gaps or areas of improvement in their curriculum. By analyzing student performance data and feedback, institutions can make data-informed decisions to enhance the curriculum and teaching methodologies.

Though it is true that predictive modelling offers significant benefits in the educational system it is essential to address the associated challenges. Below are the challenges reported in an article (Development, n.d.).

1. Predictive modeling relies heavily on accurate and comprehensive data. Ensuring data quality and maintaining student privacy can be challenging, as educational institutions need to handle sensitive student information responsibly and comply with relevant data protection regulations.

2. There is a risk of bias in predictive models, as they are built on historical data that may reflect existing biases or inequalities. It is crucial to carefully analyze and address any potential biases in the modeling process to ensure fair and equitable outcomes for all students.
3. The use of predictive modeling raises ethical concerns, particularly regarding the potential impact on student autonomy, informed consent, and the potential for stigmatization. It is important for educational institutions to address these ethical considerations and prioritize the well-being and rights of students.
4. Integrating predictive modeling techniques into existing educational systems can be challenging. It requires investment in technology infrastructure, staff training, and ongoing support to ensure successful implementation and adoption of predictive models.

Prediction Model and Academic Performance

Asiah et al. (2019) discussed the importance of predicting student academic performance to improve educational quality and support student success. However, the lack of efficient and accurate prediction models is a major challenge. Predictive analytics offers institutions the opportunity for better decision-making. The paper reviewed current research on academic analytics, focusing on predicting student academic performance. Various methods, data, techniques, algorithms, and tools have been proposed by researchers to develop effective performance prediction models.

Al-Dheleai et al. (2020) study focused on the importance of Social Presence in the learning experience and aims to develop a predictive model for students' online social presence on Social Networking Sites. SmartPLS software was used in the model development process. The study examined five facets of SP and their relationship with students' academic performance. Data for the study was collected through a survey conducted among tertiary students in Malaysia. The findings indicated a significant relationship between all five facets of online social presence and students' academic performance. SNS is identified as an appropriate tool that supports students' sense of social presence, thereby contributing to enhanced learning outcomes and academic performance. The developed model can be utilized by instructional designers, instructors, and researchers to assess students' online social presence and its impact on their academic performance.

Mathematics anxiety has been studied both as a learning outcome and a predictor variable. This study aimed to develop a structural model that explored the relationship between Mathematics anxiety, self-regulated learning, self-concept, and academic achievement. Using an interval scale questionnaire, the researchers measured latent variables and applied the PLS-SEM analysis. The results showed that Mathematics anxiety directly affected academic achievement and indirectly influenced self-regulated learning through the mediating variable of self-concept. Students with low mathematics anxiety exhibited higher levels of self-regulated learning by controlling their self-concept in Mathematics. This study emphasized the significance of addressing Mathematics anxiety and promoting self-regulated learning strategies to enhanced academic performance in mathematics (Cahyawati et al., 2023).

Musso et al. (2013) explored the use of artificial neural networks (ANN) as a methodological approach to predict academic performance. It compares the accuracy of ANN models with traditional statistical methods and examines the influence of different variables on academic performance at various levels. The research utilized cognitive and non-cognitive measures, along with background information, to develop predictive models of student performance. The ANN models demonstrated higher accuracy in predicting academic performance compared to traditional methods, such as discriminant analysis. The study provided insights into the specific influences of different variable patterns on individual learning processes and highlights the factors that best explain academic performance at different academic levels.

Alyani and Nurafni (2019) research were conducted at the University Muhammadiyah of Dr. Hamka in Jakarta, involving three academic years (2012, 2014, 2015) of mathematics education department students. The research focused on seven compulsory subjects and examined students' performance, including mid-term tests, final exams, and Grade Point Average. The study investigated the influence of gender and education background on students' achievement. Structural Equation Modeling (SEM) was employed to analyze the final model and predict the factors influencing GPA. SmartPLS software was used for data analysis, assessing the contribution of each variable to the dependent variable. The results indicated that gender significantly influenced GPA performance. Education background did not directly impact GPA but had an indirect effect through mid-term test scores. Furthermore, the study revealed that final exam scores were influenced by mid-term test scores.

Yağcı (2022) explored the use of educational data mining and machine learning algorithms to predict the final exam grades of undergraduate students. The proposed model utilizes midterm exam grades, department data, and faculty data as parameters for prediction. The study compared the performance of different machine learning algorithms and achieves a classification accuracy of 70% to 75%. The findings contributed to establishing a learning analysis framework in higher education and provided insights into early identification of students at risk of failure.

Elrahman et al. (n.d.) focused on the analysis of student data from online eTextbooks and MOOCs to predict student performance. By examining how students interact with interactive online eTextbooks, a new model was proposed for early prediction of student performance. The study addressed the prediction of good/bad performance and the final exam grade. Various classification and regression algorithms are evaluated using data from a data structures and algorithms course. The findings highlighted the potential of predictive models in identifying students at risk and facilitating timely interventions in educational settings.

The study emphasized the significance of predicting students' academic performance in advance, benefiting stakeholders like parents and higher education institutions. It proposed an intelligent decision support system that utilizes the Logistic Model Trees algorithm to predict students' performance before admission or progression in an academic program. The study identified crucial features that impact student performance and developed a prediction model based on these features. By training and testing the model on a real-world dataset, it achieved a predictive accuracy of 83.48%. This system offered valuable guidance to parents, educational institutions, and students when making decisions about program continuation or discontinuation. (Aman et al., 2019).

Adewale et al. (2018) study emphasized the importance of developing a predictive model for analyzing the academic performance of students before their admission to university. Using a feed-forward neural network, the study examined the complex relationship between cognitive and psychological variables that influence secondary school students' academic performance. The sample consisted of 120 students from randomly selected secondary schools in Ibadan-North Local Government Area. The model incorporated students' performances in five science subjects and psychological factors as inputs, with the performance at the Post-Unified Tertiary Matriculation Examination (Post-UTME) as the target output. The results demonstrated the effectiveness of the ANN in categorizing students based on their predicted performance levels.

Predictive modeling has been widely utilized in research to understand and explain the influence of various factors on academic performance. Predictive modelling tools were used to determine a model that best explains the influence of these factors. This study aims to develop a predictive model for academic performance in online learning using SmartPLS (SEM-PLS). By leveraging the capabilities of SmartPLS, this study seeks to create an effective predictive model that can accurately predict academic performance in the context of online learning.

Prediction Model and Student Learning Satisfaction

The study of Manfrin et al. (2019) involved 99 participants, resulting in a 55% response rate. Confirmatory tetrad analysis supported a reflective model for the study. The reliability and validity of the constructs, as well as the average extracted variance and discriminant validity, were confirmed. All path coefficients were positive, with five of them being statistically significant. The out-of-sample predictive power was moderate. These results demonstrate the feasibility of using PLS-SEM to develop and test a TBL conceptual model, allowing for the evaluation of path coefficients and predictive power in relation to students' satisfaction,

The research of Hou et al. (2020) focused on evaluating the impact of self-efficacy and external support on the success and persistence of the e-learning partner program. Specifically, it examined the influence of inner self-efficacy in teaching and counseling, as well as the support received from administration and equipment. The study analyzed 94 valid self-evaluation records from the 2019 academic year and conducted ANOVA, post hoc, and partial least squares (PLS) analyses.

The results revealed significant differences based on year level, experience, and teacher education program background. A network behavior model was effectively established to predict retention across four dimensions. Higher teaching self-efficacy was associated with better scores in passion and innovation compared to other factors.

Mia et al. (2022) developed a second-order partial least squares structural equation model (PLS-SEM) to examine the interaction between research-based methodologies and relationship factors that impact learning satisfaction among university students. The study utilized a simple random sampling technique for SEM analysis and collected quantitative survey data using SPSS and Smart-PLS. The research aimed to investigate the connection between teachers' strategies and their students' learning satisfaction, incorporating both research-based components and relationship approach components. These teaching techniques were found to promote student engagement and enhance learning satisfaction. The study also explored the teaching strategies that directly influence learning satisfaction at the university level, establishing a statistically significant second-order reflective model for the relationship construct. By employing first- and second-order structural equation modeling, the research examined learning satisfaction as an integral aspect of teaching strategies. The empirical findings provide valuable insights into enhancing learning satisfaction based on students' expectations.

Huynh et al. (2017) emphasized the importance of understanding the variables that relate to online learning success. Their study identified and evaluated the factors that influence students’ satisfaction with e-learning systems. The objectives of their study were to identify the significant indicators of learning satisfaction related to the use of e-learning system among Aldar University College students and then to develop an integrated model of acceptance and satisfaction. The researchers analyzed the data using SEM technique on 178 collected questionnaire responses.

Fowler (2003) noted that modeling is a way of comprehending the complexity of organizational environments, and the management systems’ dynamic intricacy. Fowler assumed that modeling is a suitable instrument for allowing managers to advance a more holistic and dynamic view. He also emphasized that modeling could support the integration of cross-functional activity within organizations.

David (2001) reported that filtering the data using models empowers further understanding. He proposed that the cognitive, predictive, decision-making, and normative are the four functions for models, seen as a sequential chain. These functions refer to the understanding and manipulation of input and output factors within a system, with the final stage being normative, theorizing the optimal relations between these factors. For the rapidly changing systems in the world of education, the model building will guide the education sector because this will help them to understand, infer, and make policy-making decisions. Models are practical and useful aid in qualitative and quantitative research where complex sets of processes are studied.

Therefore, it is vital to identify factors affecting student performance and student learning satisfaction early in order to keep them on a path of continuous improvement. The aim of this research was to identify the critical factors that influence students' performance and student learning satisfaction at the secondary level and develop an efficient predictive model by combining single and ensemble-based classifiers for accurate prediction of academic performance.

SMART PLS (Partial Least Squares) is a popular software tool used for predictive modeling, including in studies examining learning satisfaction and academic performance. It is known for its user-friendly interface and ease of use, making it accessible to researchers with varying levels of statistical expertise. SMART PLS supports SEM analysis and enables researchers to construct complex models, estimate path coefficients, assess model fit, and test hypotheses. It also offers bootstrapping for evaluating coefficient significance. SMART PLS was explored in this study and used in analysis of the relationships between the external and internal determinants (dependent variables) such as teaching quality, learning management system, learning guide, assessment, gender, academic self-concept, academic motivation, interest to learn and mental well-being to learning satisfaction and academic performance.

SmartPLS (SEM-PLS) as a Tool in Prediction Modelling

In a pilot study conducted by Munir (2018), the researcher used SMARTPLS to examine the relationship between learning space attributes (such as environment, design, and facilities) and student satisfaction and perceived performance in an academic building. The study involved 50 students who completed a questionnaire using a five-point Likert scale to express their preferences. The results indicated a significant association between learning space attributes and student satisfaction and perceived performance. All independent variables showed significance, emphasizing the importance of the learning environment, design, and facilities in influencing student satisfaction and perceived performance. The pilot study utilized PLS-SEM: SMART-PLS Version 3.2 to assess the questionnaire's reliability and validity, confirming its suitability for the main data collection in the intended study and meeting the required standards for reliability and validity.

A study by Fitrianti and Saparuddin (2018) reported an important result in elevating the performance of students in Mathematics. The study used the SEM in identifying the factors that affect students' learning achievement. Based on the results reported, internal and external factors directly influenced the student achievement in Mathematics learning. They also found that the internal factors do not significantly influence the external factors.

Alyani and Nurafni (2019) in their research entitled “Structural Equation Modeling in predicting student performance in Mathematics” used SmartPLS software to analyze the contribution of each variable to the outcome and dependent variable. The results of the study showed that gender significantly influences their performance on their GPA. Similarly, Ramli et al. (2018) used the same analysis tool when they conducted their research on external factors, internal factors, and self-directed learning readiness.

The study by Akwene and Fouda (2022) presented a new technology adoption model called Multimedia-Influence-Achievement Model that examined the impact of multimedia exposure on learning motivation and academic achievement. The study was conducted among 354 secondary school students in Yaounde. Using (SEM), the analysis validated the model and revealed significant positive relationships between multimedia exposure, multimedia self-efficacy, attitude toward multimedia, and learning motivation. It was also found that learning motivation predicts academic achievement.

Huang (2021) explored the influencing factors of learning satisfaction in blended learning. Three dimensions are proposed: perceived usefulness, perceived ease of use, and learning motivation. It studied how these variables affect students' learning satisfaction. The questionnaire survey method was applied in this research to analyze the relationship between the variables and verify the hypothesis based on the collected 173 valid questionnaires. The PLS-SEM is used to carry out structural equation modeling to study the relationship between latent variables. It explained that the perceived ease of use affects the perceived usefulness. Perceived usefulness and perceived ease of use have a positive impact on learning motivation. Learning motivation has a positive impact on learning satisfaction. Perceived usefulness as an intermediary factor of perceived ease of use has an indirect impact on learning motivation.

The study of Yahiaoui et al. (2022) focused on the impact of e-Learning systems on student motivation and outcomes in higher education, particularly in Algerian universities during the COVID-19 pandemic. The research employed a mixed-method approach, using surveys to collect data from 398 students. The analysis included qualitative analysis of open-ended questions using Nvivo and quantitative analysis of Likert scale questions through SEM with Amos. The findings indicate that e-Learning systems significantly influence student motivation (Attention, Relevance, Confidence, and Satisfaction) and student outcomes (knowledge, skills, and attitudes). Factors such as Technical and electronic requirements, personal requirements, perceived value, and credibility of e-Learning play a crucial role in shaping these effects.

Another study by My et al. (2022) focused on the relationship between factors promoting learner satisfaction and e-learning outcomes among online learners in private universities in Ho Chi Minh City, Vietnam. The research utilizes the technology-mediated learning approach and employs the PLS SEM method. The independent variables examined include student motivation, student self-regulation, teacher-student dialogue, student-student dialogue, activities, course structure, technology quality, and LMS tools and features. The dependent variable is e-learning outcomes. The findings revealed that student-to-student dialogue, course structure, and technology quality have a positive and significant influence on learner satisfaction, which, in turn, correlates with learner outcomes.

SMARTPLS (PLS-SEM) is usually used to carry out structural equation modeling and predict the factors affecting student satisfaction. This study makes use of the same instrument because of the similarity in the above-cited literature.

Conceptual Framework

The present study aims to investigate the factors that influence student learning satisfaction in an online mode of learning, drawing on the social-cognitive theory proposed by Albert Bandura (1986). Bandura's theory suggests that learning outcomes are influenced by a combination of cognitive, behavioral, and environmental variables. Unlike traditional psychological theories that emphasize direct experience, Bandura posits that learning can also occur through observation of others' behaviors and the consequences they face. Understanding the determinants of student learning satisfaction in an online learning environment is crucial for improving educational practices and enhancing student engagement.

The conceptual framework presented in Figure 2.1 illustrates the internal and external determinants of student learning satisfaction within the context of online learning, as proposed by Bandura's social-cognitive theory.

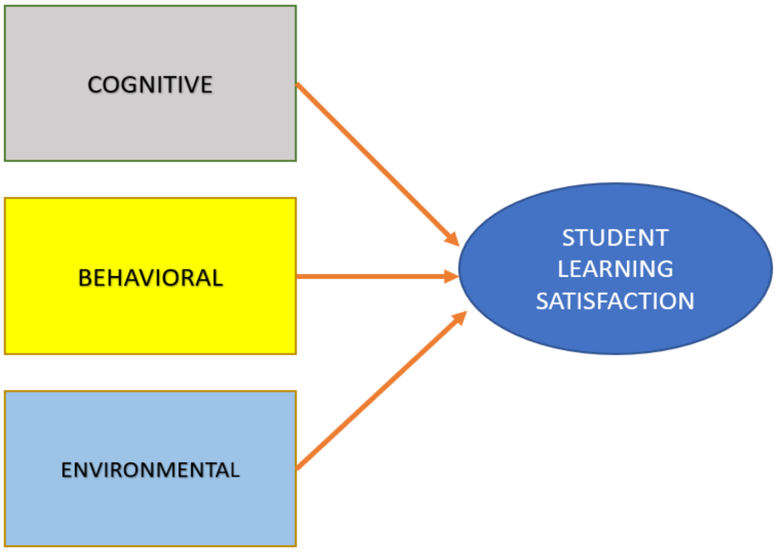


Figure 2.1. Bandura's theory of learning satisfaction (1986)

1. Cognitive Determinants

   Cognitive includes the individual's characteristics such as prior knowledge, cognitive abilities, and learning styles. Students with higher cognitive abilities and compatible learning styles are more likely to engage effectively in online learning, leading to increased learning satisfaction.

2. Behavioral Determinants

   a. Observational Learning: Bandura's theory suggests that students can learn by observing and imitating the behaviors of others. In an online learning environment, observing and modeling successful behaviors exhibited by peers or instructors can enhance learning satisfaction.

   b. Self-Regulation: The ability to set goals, plan, monitor progress, and adjust strategies accordingly is vital for effective online learning. Students who possess strong self-regulatory skills are more likely to experience higher levels of learning satisfaction.

3. Environmental Determinants

   a. Social Interactions: Collaborative learning, peer interactions, and instructor support play significant roles in online learning satisfaction. Positive social interactions, such as group discussions and feedback, contribute to a sense of belonging and satisfaction in the online learning community.

   b. Technological Factors: The availability and quality of technological tools and resources directly impact students' learning experience and satisfaction. Reliable internet connectivity, user-friendly platforms, and access to relevant digital resources are crucial for a positive online learning environment.

In this study, these cognitive, behavioral, and environmental factors are alternatively categorized into external and internal factors that predict student learning satisfaction. Many studies focused on a variety of theories relating internal and external factors to learning satisfaction mostly in the pre-pandemic traditional learning environment. The abrupt change into online learning results in a more complex dynamic of learning satisfaction. The incorporation of digital learning modes such as learning management systems (LMS) and the internet (Google, Youtube, etc.) becoming the main source of learning for the students changes the usual learning environment.

The conceptual framework lies in the assumption that external determinants (Teacher, Assessment, learning guides, and KHub) and internal determinants (gender, academic performance, academic self-concept, academic motivation, interest to learn, and mental well-being) all contribute to the general learning satisfaction of the learners in the online platform for learning.

By examining the internal and external determinants of student learning satisfaction within an online learning context, this study provides valuable insights for educators and instructional designers to enhance the effectiveness and quality of online learning experiences. By considering cognitive, behavioral, and environmental factors, educators can design interventions that optimize student engagement, motivation, and satisfaction, ultimately leading to improved learning outcomes in online education.

High SLS implies that the learning factors are working to impact students' thinking and learning toward academic success resulting in high grades. The survey in this study serves to gather the student's perception/response on their own learning satisfaction for each learning factor during this remote learning modality. Several factors may influence student learning satisfaction, either positively or negatively. Positive influences may cause the student to enjoy learning and the learning processes while negative influences may result in the student's complaints about the learning processes. External and internal factors are the usual indicators that could influence student learning satisfaction. The external factors in this study include teachers, assessment tools, learning guides, and the knowledge hub used to implement online learning. The Internal factors include gender, academic motivation, self-concept, interest in learning, mental well-being, and academic performance.

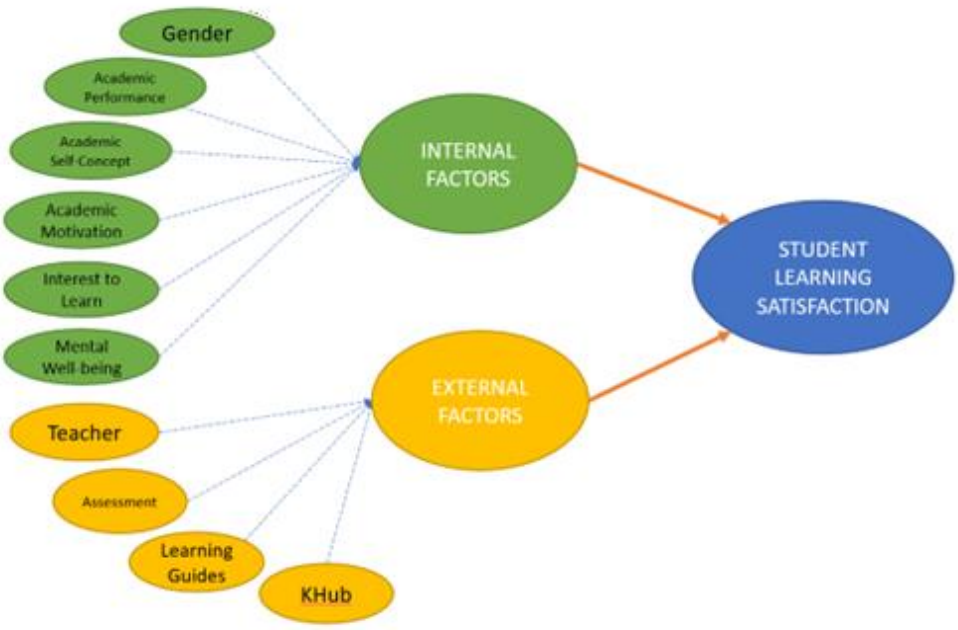


Figure 2.2 Internal and External Factors and Student Learning Satisfaction

The internal and external factors are designated as the determinants in this study which will be tested for significant relationships or influence with the student learning satisfaction and academic performance of PSHS CARC Chemistry students. Figure 2.2 is the proposed relationships between these external and internal factors to student learning satisfaction.

In this study, all learning determinants (external and internal) are assumed to significantly affect student learning satisfaction directly and the correlation is statistically computed to determine which of the determinants significantly directly influences student learning satisfaction. Aside from direct relations to SLS, to also find out which of the determinants have indirect relation with SLS, the connection of each determinant with all other determinants is also determined (see Figure 2.3).

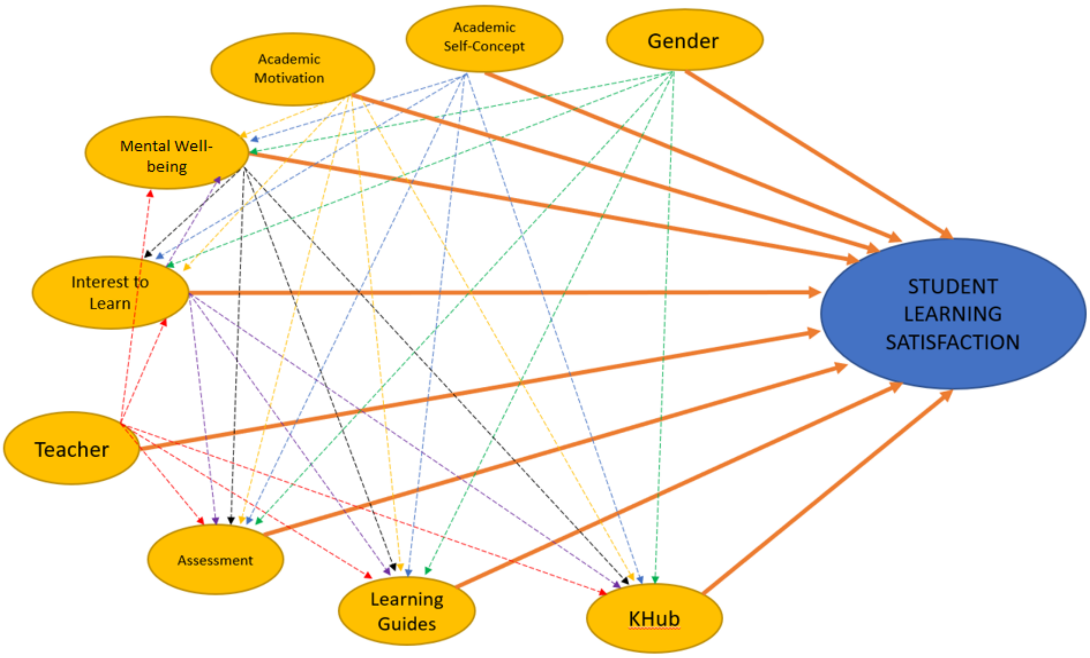


Figure 2.3. The Conceptual Framework of the Study

The direct and indirect relations between the determinants and the SLS will guide the development of SLS models for each Grade level of Chemistry learner. The study will also consider the data of the student's academic performances or grades in their Chemistry courses for the academic performance models for each grade level.

Thus, aside from the SLS model, the academic performance model of the Chemistry students was also determined.

Research Hypotheses

1. The external determinants (Teacher-related indicators; Assessment-related indicators; Learning guides-related indicators, and KHub-related indicators) and internal determinants (Academic self-concept; Academic motivation; Academic performance; Interest to learn; and mental well-being) have a direct influence on the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects.

2. The external determinants (Teacher-related indicators; Assessment-related indicators; Learning guides-related indicators, and KHub-related indicators) and internal determinants (Academic self-concept; Academic motivation; Academic performance; Interest to learn; and mental well-being) indirectly influences the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects

3. a. Enjoyment derived from the learning process positively influences the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects.

b. Complaints related to the learning experience negatively influence the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects.

4. The SLS model that incorporates all the identified external and internal factors will significantly correlate with the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects.

5. The AP model that incorporates the academic performance of students as a determinant will best represent the learning satisfaction of PSHS CARC students enrolled in Chemistry subjects.

Definition of Terms

Academic Performance – is the individual's ability to demonstrate the knowledge, skills, and competencies in Chemistry. It is assessed through exams, quizzes, assignments, and other learning activities. The student's academic performance in this study is measured in terms of their Chemistry grades.

Academic Performance Model – is a representation showing direct and indirect relations of the determinants (internal and external) and the student's academic performance in Chemistry.

Asynchronous online learning – is an online learning which permits students to access instructional materials any time they choose, Student may choose to do the assigned task or watch a pre-recorded/recorded video to understand the topic/s.

External factors – refer to the environmental and contextual variables that can influence the student's learning experiences and outcomes. In this study, it includes the teacher-related indicators, assessment-related indicators, Learning Guide-related indicators, and KHub-related indicators.

Teacher-related indicators:

Availability for consultations: The extent to which the teacher is accessible to students for consultation, clarification, or support outside the regular class hours or sessions.

Quality of instruction: The degree to which the teacher's teaching methods, techniques, and strategies are effective in facilitating student learning and achieving learning objectives.

Punctuality in synchronous sessions: The extent to which the teacher is prompt and adheres to the scheduled time for synchronous or real-time class sessions.

Timeliness in returning outputs: The speed and efficiency with which the teacher provides feedback, grades, or test results to students.

Timeliness in giving feedback: The speed and efficiency with which the teacher provides feedback on student performance, progress, or areas for improvement.

Considerate/Understanding: The degree to which the teacher is empathetic, compassionate, and accommodating towards the needs, challenges, or circumstances of the students.

Fairness: The extent to which the teacher’s grading, assessment, or evaluation procedures are unbiased, transparent, and consistent across all students.

Assessment tools-related indicators:

Level of difficulty: The degree to which the assessment tasks or activities challenge and stretch the students' cognitive abilities and skills.

Level of engagement: The extent to which the assessment tasks or activities foster active participation, interest, and motivation among the students during asynchronous and synchronous meetings.

Alignment with learning objectives: The degree to which the assessment tasks or activities are aligned with the intended learning outcomes, goals, or competencies.

Format of activities or outputs: The type, nature, or mode of the assessment tasks or activities, such as presentations, video, reaction paper, projects, etc. found in the learning guides and Knowledge Hub.

Length of activities: The duration or time required to complete the assessment tasks or activities in the learning guides and Knowledge Hub.

Instruction on the process: The clarity, detail, and comprehensiveness of the instructions, guidelines, or rubrics provided for the assessment tasks or activities in the learning guides and Knowledge Hub.

Number of assessments/activities: The frequency or quantity of the assessment tasks or activities required for the course or subject in the learning guides and Knowledge Hub.

Duration of deadlines: The period or timeline given to students for the submission of the assessment outputs or activities.

Learning guide-related indicators:

Clarity: The degree to which the learning guides or materials are clear, concise, and easy to understand.

Creativity: The level of creativity, innovation, or novelty in the design, format, or presentation of the learning guides or materials.

Completeness of the content: The degree to which the learning guides or materials cover all the necessary topics, concepts, or skills required for the course or subject.

Time allotment: The appropriate and reasonable amount of time or duration allotted for each topic in the learning guide.

Modularity: The degree to which the learning guides or materials are broken down into manageable, bite-sized chunks or modules.

Quantity: The number of learning guides or materials provided for the course or subject, as well as the number of topics or subtopics covered within the quarter.

Knowledge hub-related indicators

Accessibility: The ease of access and availability of the knowledge hub as the online platform for the students.

Response time: The speed and efficiency with which the knowledge hub as the online platforms responds to student concerns, or technical issues. Response time usually refers to the time it takes for the KHub to respond to a user's action or request.

Ease of navigation: the degree to which the knowledge hub or online platform is user can easily and intuitively move around or access different parts of a digital platform, website, or application without experiencing confusion, difficulty, or frustration. It involves the clarity and organization of menus, links, buttons, and other navigational elements that enable users to locate and interact with the content or functionality.

Internal factors – refer to the personal and psychological variables that can influence the student's learning experiences and outcomes. In this study, internal factors include the student's academic self-concept, academic motivation, interest to learn, mental well-being as well as age and gender.

Academic Performance- refers to students' achievements upon completing a course. This study focused on evaluating the academic performance of students based on their Chemistry grades, which were obtained from their examination results and other relevant outputs.

Academic Self-Concept – refers to the student's perception of their own abilities and competencies in terms of academics. It encompasses an individual's beliefs about their academic strengths and weaknesses, as well as their overall sense of confidence and self-efficacy in relation to their academic performance. This is determined by an Academic Self-concept survey questionnaire where each student rates their own perception of their academic self-concept level whether they are (1) strongly unsatisfied, (2) unsatisfied (3) neutral - neither unsatisfied nor satisfied (4) satisfied, and (5) strongly satisfied.

Academic motivation- refers to the desire or drive of the student to engage in learning. This is determined by the Academic Motivation survey questionnaire where each student rates their own perception of their academic motivation level whether they are (1) strongly unsatisfied, (2) unsatisfied (3) neutral - neither unsatisfied nor satisfied (4) satisfied and (5) strongly satisfied.

Interest to learn – refers to the student's curiosity and enjoyment of learning in Chemistry which motivates the student to be involved in learning activities and learning experiences. It is determined by an Interest to Learn survey questionnaire where each student rates their own perception of their interest to learn level whether they are (1) strongly unsatisfied, (2) unsatisfied (3) neutral - neither unsatisfied nor satisfied (4) satisfied and (5) strongly satisfied.

Mental well-being – is the state of an individual's emotional and psychological health characterized by positive feelings, thoughts, and behaviors. This is determined by a Mental Well-being survey questionnaire where each student rates their own perception of their mental well-being level whether they are (1) strongly unsatisfied, (2) unsatisfied (3) neutral - neither unsatisfied nor satisfied (4) satisfied and (5) strongly satisfied.

Gender - refers to the biological and psychological characteristics that define an individual. In this study, the gender is classified as either male or female where gender appears to be a binary categorization: male students were designated with a numerical value of 0 while female students were designated with a value of 1. Gender is being measured as a categorical variable with two distinct levels.

Online learning – (also called e-learning) is a type of distance learning where education occurs over the Internet During the pandemic period, online learning was conducted synchronously through Google meet or Zoom meetings and asynchronously using Learning Management Systems like Knowledge Hub.

SLS Model – is a representation showing direct and indirect relations of the determinants (internal and external) and the student learning satisfaction of students in Chemistry.

Student Learning Satisfaction – defined as the level of contentment or fulfillment experienced by students regarding their academic learning, influenced by various external determinants and Internal determinants. External determinants, such as teacher-related indicators, assessment-related indicators, learning guide-related indicators, and knowledge hub-related indicators. Internal determinants included in this study are academic self-concept, academic motivation, interest to learn, and mental well-being. The degree of the student’s learning satisfaction on each of these factors is determined in a learning satisfaction survey questionnaire where each student rates their own perception of their learning satisfaction level whether they are (1) strongly unsatisfied, (2) unsatisfied (3) neutral - neither unsatisfied or satisfied (4) satisfied and (5) strongly satisfied. Definition of internal and external factors were discussed above.

Synchronous online learning – is a mode of online learning in which students and instructors participate in live, real-time interactions through digital communication tools such as video conferencing, chat rooms, or instant messaging. In synchronous online learning, students and instructors are not physically in the same place but they are expected to be present and engaged at the same time, and learning activities are structured to occur simultaneously. This mode of online learning necessitates the students and the teacher to have stable internet connection and appropriate technology to participate actively in the live sessions**.**

CHAPTER III

METHODOLOGY

This chapter provides an overview of the key components involved in conducting the research study. It outlines the research design, sample selection, survey instrument development, data collection process, data analysis using SmartPLS, and the model-building procedure. These components are essential for ensuring the validity, reliability, and rigor of the research findings.

Research Design

This study aimed to develop a comprehensive Student Learning Satisfaction (SLS) model and Academic Performance (AP) model to effectively describe the PSHS CARC Chemistry students. The SLS Model aimed to identify the determinants that directly or indirectly impact student learning satisfaction for each Grade level Chemistry subject.

To achieve this objective, a correlational research design was implemented, utilizing a cross-sectional and quantitative approach. Five-point Likert scale questionnaires served as the primary instrument for investigating the relationships between variables without the researcher controlling or manipulating them. The analysis of correlations aimed to assess the strength of the relationship between the variables and students' learning satisfaction.

Additionally, this study aimed to evaluate the experiences of PSHS students regarding the implementation of online learning. Therefore, a qualitative research design was incorporated. Open-ended questions were used as the data collection instrument, carefully tailored to the specific objectives of the study. The collected data underwent qualitative content analysis, enabling a deeper understanding of the students' perspectives and experiences.

Qualitative content analysis is a research method used to systematically analyze and interpret textual or visual data in a qualitative research study. It involves analyzing qualitative data, such as interview transcripts, field notes, documents, or other forms of text, to identify and interpret patterns, themes, and meanings within the data. In this study, the answer of the participants in the questions included in each survey questionnaire will be analyze using the steps below:

Data Preparation: The relevant textual or visual data for analysis will be collected. This is done by transcribing the interviews, gathering of documents, or organizing field notes.

Coding: The data were read carefully, line by line, and assigned descriptive codes or labels to different segments of the data. These codes capture the content or meaning of each segment and help categorize the data into meaningful units.

Category Development: As coding progresses, the patterns and connections among the codes are identified. Similar codes are grouped together to form categories or themes that represent broader concepts or ideas within the data. This involves developing a coding scheme or framework to guide the analysis.

Data Exploration: Once the initial coding and categorization are complete, the data are explored within each category or theme. This involves comparing different segments of data to identify similarities, differences, relationships, and underlying meanings.

Interpretation: The data generated will be interpreted by generating explanations, insights, and explanations about the phenomenon under study. This can involve examining the relationships between categories, identifying key findings, and providing a rich and nuanced understanding of the data.

Reporting: Finally, the findings of the qualitative content analysis will be presented in a coherent and meaningful way. In this study, writing a narrative description of the key themes, illustrating findings with selected quotes or examples, and providing a comprehensive account of the analysis process will be done.

Qualitative content analysis extracts meaning and interpretive insights from textual or visual data. It is a flexible and iterative process that requires careful attention to detail, critical thinking, and an openness to emergent themes and patterns within. The qualitative results confirmed the SLS and AP models from this study.

This study primarily aimed to investigate the relationships between the selected determinants and with both SLS and AP. The correlations were examined using SmartPLS software to uncover the SLS and AP models. Furthermore, significant correlations between individual determinants and all other determinants were considered. The final SLS model and AP model would be determined based on the significant correlations identified using SmartPLS.

The Sample

The population of the study was Grade 9 to Grade 12 students enrolled in Chemistry classes at PSHS CARC during the school year 2021-2022. Based on the actual data from the PSHS CARC Registrar's office, the total population of Grade 9 to Grade 12 students enrolled in chemistry classes is presented in Table 3.1.

Table 3.1
Population of Grade 9 to Grade 12 students enrolled in Chemistry classes during the SY 2021-2022

Grade level	Male	Female	Total
9	37	53	90
10	36	53	89
11	12	23	35
12	15	20	35
Total	100	149	**249**

The study used Cochran's formula to identify the minimum sample size, at 95% confidence level, 50% population proportion, and 5% margin of error, the minimum sample size for the target population using Cochran' formula was 152.

At 90% assumed participation rate, the target number of respondents was 130. Table 3.2 shows the number of respondents participated per grade level.

Simple random sampling was used to draw the participants of the study. Each student per grade level was assigned a number, and those randomly selected were informed and given the choice to complete the survey either online or in-person.

Before the implementation of the survey questionnaires the researcher set an orientation meeting to the selected teachers and PSHS staff who will guide the students in answering the questionnaire. The teachers and staff monitored the students synchronously or in-person during the survey. The questionnaire was made accessible to the selected students through a survey site URL and a survey code was assigned to each student. While students had the option to use their real name, their identities were kept confidential, and their responses were tagged using the survey code. Out of the total population of 249 students enrolled in the Chemistry course, 169 students responded. Table 3.2 provides a summary of respondents for each grade level included in the model development.

Table 3.2
Participants per grade level

Grade Level	Male	Female	Total number of participants
Grade 9	26	30	56
Grade 10	35	38	73
Grade 11	9	12	21
Grade 12	5	14	19
TOTAL	75	94	**169**

The Data Gathering Instruments

The study utilized a set of instruments to collect data and assess various aspects of student learning satisfaction, academic self-concept, academic motivation, interest in learning, and mental well-being. The modified student satisfaction survey by Fieger (2012), based on the student satisfaction survey used by PSHS during the pandemic period, was employed to gather data on PSHS students' satisfaction levels in relation to learning determinants such as teachers, assessments, learning guides, and KHub.

To explore students' attitudes, feelings, and thoughts about themselves in relation to learning, the researchers modified the Academic Self-concept survey questionnaire originally developed by Raynor & White (2013). This questionnaire aimed to probe students' self-perceptions and confidence regarding their academic abilities.

The Academic Motivation survey questionnaire, adapted from Ansari et al. (2021), was used to measure students' motivation levels specifically in the context of learning chemistry. This instrument sought to assess the degree of motivation students exhibited towards their chemistry studies.

To evaluate students' interest in learning chemistry, the researchers created an Interest to Learn survey based on a sample derived from the Student Interest and Learning Style Survey for Social Studies (n.d.). This survey consisted of questions that analyzed and probed the factors influencing students' interest in the subject. Students were asked to rate their level of interest in learning chemistry and provide reasons for their motivation to learn.

To assess students' mental well-being, the researchers employed the Mental Well-being survey questionnaire, which was adapted from The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and the literature by Tennant et al. (2007). This questionnaire measured students' well-being across various dimensions and categories.

The instruments, including the questionnaires mentioned above, underwent content validation by experts to ensure their relevance and effectiveness. A collection of sample-validated questionnaires can be found in Appendices L, M, N and O.

To calculate the content validity, index the formula by Lawshe (1975) was used. Content validity refers to the extent to which the instrument adequately covers the construct being measured. It plays a critical role in scale development by ensuring that the survey items accurately represent the intended content and effectively capture the construct under investigation. To assess the content validity of the survey instrument, the Content Validity Index (CVI) was calculated. The CVI is the average Content Validity Ratio (CVR) score of all the questions in the test. A higher CVI value, closer to 1, indicates higher content validity. The CVI values obtained for the survey questionnaire were as follows: Academic self-concept (ACS) is 0.905; Academic Motivation (AM) is 0.939; Interest to Learn (IL) is 1.0 and Mental well-being (MW) is 1.0. These results demonstrate that the developed survey questionnaires exhibit high content validity. Table 3.3 (A, B, C and D) provides the summary of the content validity index for the implemented survey questionnaires. The x marks in the column of “Experts” means that the expert assessed the questionnaire item (row) to be valid.

Table 3.3

Content validity index of the modified survey questionnaires (Academic Self-Concept, Academic Motivation, Interest to Learn and Mental Well-being)

A. Content validity Index of Academic Self-Concept Questionnaire

Academic Self-concept	Expert 1	Expert 2	Expert 3		CVR
Item 1	x	x	x		1
Item 2	x	x	x		1
Item 3	x	x	x		1
Item 4	x	x	x		1
Item 5	x	x	x		1
Item 6	x	x	x		1
Item 7	x	x			0.333
Item 8	x	x	x		1
Item 9	x	x	x		1
Item 10	x	x			0.333
Item 11	x	x	x		1
Item 12	x	x	x		1
Item 13	x	x	x		1
Item 14	x	x	x		1
Item 15	x	x	x		1
Item 16		x			-0.333
Item 17	x	x	x		1
Item 18	x	x	x		1
Item 19	x	x	x		1
Item 20	x	x	x		1
Item 21	x	x	x		1
Item 22	x	x	x		1
Item 23	x	x	x		1
Item 24	x	x	x		1
Item 25	x	x	x		1
Item 26	x	x	x		1
Item 27	x	x	x		1
Item 28	x	x	x		1
Item 29	x	x	x		1
Item 30	x	x	x		1
Item 31	x	x	x		1
Item 32	x	x	x		1
Item 33	x	x			0.333
Item 34	x	x	x		1
Item 35	x	x	x		1
CVR(Critical) for a panel size (N) of 3 is 1.667.				CVI	0.905

B. Content validity Index of Academic Motivation Questionnaire

Academic Motivation	Expert 1	Expert 2	Expert 3		CVR
Item 1	x	x	x		1
Item 2	x	x	x		1
Item 3	x	x	x		1
Item 4	x	x	x		1
Item 5	x	x	x		1
Item 6	x	x	x		1
Item 7	x	x	x		1
Item 8	x	x	x		1
Item 9	x	x	x		1
Item 10	x		x		0.333
Item 11	x	x	x		1
CVR(Critical) for a panel size (N) of 3 is 1.667.				CVI	0.939

C. Content validity Index of Interest to Learn Questionnaire

Interest to Learn	Expert 1	Expert 2	Expert 3		CVR
Item 1	x	x	x		1
Item 2	x	x	x		1
Item 3	x	x	x		1
Item 4	x	x	x		1
Item 5	x	x	x		1
Item 6	x	x	x		1
Item 7	x	x	x		1
Item 8	x	x	x		1
Item 9	x	x	x		1
Item 10	x	x	x		1
Item 11	x	x	x		1
CVR(Critical) for a panel size (N) of 3 is 1.667.				CVI	1

D. Content validity Index of Mental Well-Being Questionnaire

Mental Well-Being	Expert 1	Expert 2	Expert 3		CVR
Item 1	x	x	x		1
Item 2	x	x	x		1
Item 3	x	x	x		1
Item 4	x	x	x		1
Item 5	x	x	x		1
Item 6	x	x	x		1
Item 7	x	x	x		1
Item 8	x	x	x		1
Item 9	x	x	x		1
Item 10	x	x	x		1
Item 11	x	x	x		1
Item 12	x	x	x		1
Item 13	x	x	x		1
Item 14	x	x	x		1
CVR(Critical) for a panel size (N) of 3 is 1.667.				CVI	1

Reliability of External and Internal Determinant Questionnaires

The survey questionnaires administered to assess teacher satisfaction, assessment satisfaction, learning guide satisfaction, and KHub satisfaction underwent a Cronbach's alpha test to measure their reliability. The Cronbach's alpha coefficients obtained for each construct were 0.860, 0.820, 0.818, and 0.752, respectively. These coefficients indicate the internal consistency of the items within each construct.

Table 3.4 presents Cronbach's alpha values for each of the external and internal determinants assessed in the study. The Cronbach's alpha statistic is commonly used to evaluate the reliability of a scale or questionnaire. It measures the extent to which the items within a construct correlate with each other and provide consistent results. Higher Cronbach's alpha coefficients generally indicate greater internal consistency and reliability of the scale.

In this study, the Cronbach's alpha coefficients of 0.860, 0.820, 0.818, and 0.752 suggest good internal consistency for the teacher satisfaction, assessment satisfaction, learning guide satisfaction, and KHub satisfaction questionnaires, respectively. These values indicate that the items within each questionnaire are highly correlated and provide reliable measurements of the corresponding variables.

Table 3.4
Cronbach's Alpha and Composite Reliability of Survey Questionnaires

Survey Questionnaire	Cronbach's Alpha	Composite Reliability
ASC	0.899	0.958
AM	0.902	0.924

IL	0.929	0.957
MW	0.942	0.950
TEACHER	0.860	0.868
ASSESSMENT	0.820	0.845
LG	0.818	0.824
Khub	0.752	0.762

A high Cronbach’s alpha (typically above 0.7) suggests that the items are highly correlated and contribute consistently to measuring the construct, or in this case, the questionnaire. Based on Cronbach's Alpha and composite reliability values in Table 3.4, all survey questionnaires are considered reliable and consistent.

Modified Student Learning Satisfaction Survey (Appendix G)

The modified student learning satisfaction survey was developed by adapting the student satisfaction survey conducted by Fieger (2012) to suit the specific context of online learning at PSHS (Philippine Science High School). This survey questionnaire was designed with various sub-categories to comprehensively assess different aspects of the online learning experience.

The survey was divided into the following sub-categories:

Teacher Satisfaction Survey: This section comprised eight indicators aimed at evaluating students' satisfaction with their teachers in the online learning environment.

It assessed factors such as teacher has a thorough knowledge of the subject content, teacher communicated the subject content effectively, Punctuality in synchronous sessions, timeliness in returning outputs, timeliness in giving feedback, considerate /understanding, fairness, and availability for consultation.

Assessment Satisfaction Survey: In this section, students' satisfaction with the assessment methods employed in the online learning program was assessed using seven indicators. It examined aspects such as level of difficulty, level of engagement, format of activities or outputs, length of activities, instruction on the process, number of assessments/activities, duration of deadlines.

Learning Guide Satisfaction Survey: With six indicators, this section aimed to gauge students' satisfaction with the learning guides provided during online learning. It considered factors such as clarity, creativity, completeness of the content, time allotment, modularity, quantity (no. of LGs, no of topics).

KHub Satisfaction Survey: The KHub satisfaction survey consisted of five indicators and focused on assessing students' satisfaction with the KHub platform, which is used for course management and collaboration. Factors evaluated included accessibility, response time, ease of navigation, ease of use and notification feature.

In addition to these sub-categories, an Overall Satisfaction Survey was included to obtain a holistic understanding of students' satisfaction with the overall online learning experience. This section allowed students to provide an overall assessment of their learning satisfaction, To gain deeper insights into students' experiences, two open-ended questions were included within each category. These open-ended questions encouraged students to provide qualitative feedback and share their personal experiences, thereby providing a more nuanced understanding of their perceptions of online learning,

The survey questionnaire utilized a 5-point Likert scale, allowing students to indicate their satisfaction levels. The scale ranged from "Strongly Satisfied" to "Strongly Unsatisfied," providing students with a structured format to express their level of satisfaction across the various survey indicators.

Modified Academic Self-concept survey questionnaire (Appendix H)

The ASC (Academic Self-Concept) questionnaire was initially developed by Raynor and White in 2013. It aims to capture individuals' perceptions and attitudes towards themselves. The modified questionnaire consists of 35 questions designed to assess various aspects of self-perception of PSHS students enrolled in chemistry courses.

To measure agreement levels, the ASC questionnaire utilizes a 5-point Likert scale. Participants are provided with response options ranging from "Strongly Agree" to "Strongly Disagree." This scale allows students to indicate their agreement or disagreement with the statements presented in the questionnaire.

Modified Academic Motivation survey questionnaire (Appendix I)

The revised Academic Motivation (AM) questionnaire was adapted from Ansari et al. (2021) and aims to assess individuals' levels of motivation and the factors influencing their academic engagement. It consists of 12 statements carefully designed to gather information about different aspects of academic motivation.

To measure agreement levels, the AM questionnaire utilizes a 5-point Likert scale. Participants are provided with response options ranging from "Strongly Agree" to "Strongly Disagree." This scale allows students to indicate their degree of agreement or disagreement with the statements presented in the questionnaire, enabling a more nuanced understanding of their motivations.

Modified Interest to Learn survey questionnaire (Appendix J)

The modified Interest to Learn survey was developed using a sample extracted from the Student Interest and Learning Style Survey for Social Studies (n.d.). It consists of 11 statements designed to collect data about an individual's learning interests and assists in identifying their preferences, motivations, and goals in relation to knowledge acquisition.

To gauge agreement levels, the IL questionnaire employs a 5-point Likert scale. Participants are presented with response choices spanning from "Strongly Agree" to

"Strongly Disagree." This scale enables students to express the extent of their agreement or disagreement.

Modified Mental Well-Being survey questionnaire (Appendix K)

The revised Mental Well-being survey questionnaire is an adaptation of The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) and incorporates insights from the literature by Tennant et al. (2007). This questionnaire aims to assess students' well-being across various dimensions and categories. It comprises 14 statements that measure different aspects of an individual's mental well-being, specifically tailored to gather information about their emotional state and psychological functioning during online learning.

To capture agreement levels, the MW questionnaire utilizes a 5-point Likert scale. Participants are provided with response choices ranging from "Strongly Agree" to "Strongly Disagree." This scale allows students to indicate the degree of their agreement or disagreement with the statements.

Ethical Consideration

This section outlines the pertinent considerations and methodologies utilized in this study, with a focus on ensuring ethical soundness. The following aspects have been given careful attention: informed consent, openness and integrity, protection from harm, and confidentiality. These elements are crucial in maintaining the ethical integrity of the study.

The ethical clearance for the conduct of the study was granted last May 16, 2022, by the Philippine Science High School Research Ethics Committee. Also, the study was endorsed by the Campus Director of PSHS Cordillera Administrative Region campus.

Parents' Consent and Assent

To ensure that both parents and students were fully informed about the purpose of the research, the procedures involved, the potential risks and benefits, and other pertinent details of the study, parents' consent form was obtained from parents and guardians, while assent form was obtained from students prior to conducting the study. The process involved providing a consent and assent form, which consisted of an information sheet and a certificate of consent and assent.

The information sheet included various sections, such as an introduction, the purpose of the study, participant selection criteria, voluntary participation, study procedures, potential risks and safeguards, anticipated benefits, confidentiality measures, sharing of results, the right to refuse or withdraw from the study, and contact information for further inquiries. Conversely, the certificate of consent and assent was signed by parents and students to indicate their agreement to participate in the study.

Once the respondents for the study were randomly selected, the parent consent and assent forms were distributed to them via email. To ensure clarity, the researcher conducted an online orientation session, explaining the contents of the parents' consent and assent forms. Following the presentation, parents and students were given the opportunity to ask questions or seek clarifications regarding the study. After considering the information provided, parents and students made their decision and signed the consent/assent form, which they subsequently submitted via email. This form served as evidence of their voluntary participation in the study.

Protection from Harm

In response to the restrictions imposed by the COVID-19 pandemic, the data gathering process for the study was adapted to ensure the safety and well-being of the participants. Two approaches were utilized, depending on the availability of the students and the prevailing circumstances: remote data gathering and face-to-face data gathering with adherence to safety protocols.

For remote data gathering, students were provided with the link and were asked to answer it in the presence of a PSHS staff or teacher to guide them. This approach allowed for flexibility in participation, considering the varied situations and limitations experienced by the students. The Philippine Science High School (PSHS) staff and Chemistry teachers played a crucial role in facilitating and guiding the students through the data gathering process, providing support and clarifications as needed.

In instances where face-to-face data gathering was feasible and permitted, strict safety protocols were implemented. These protocols adhered to the guidelines and recommendations set forth by local health authorities. The PSHS staff and chemistry teachers ensured that all necessary precautions, such as wearing masks, maintaining physical distancing, and sanitizing equipment, were strictly followed to minimize the risk of COVID-19 transmission.

To foster a comfortable and inclusive environment, open-ended questions were incorporated into the questionnaire. This allowed students to provide detailed responses and share their thoughts freely. However, it was emphasized that participation in answering these questions was voluntary, and students were given the option to skip any question they felt uncomfortable answering.

Recognizing the importance of breaks and considering the potential fatigue associated with data gathering, scheduled breaks were provided when needed. These breaks allowed the students to rest and recharge, promoting their overall well-being and ensuring that the quality of their responses was not compromised.

Throughout the entire data gathering process, both parents and students were informed of their rights and given the opportunity to withdraw their participation if they felt any inconvenience or discomfort. The PSHS staff and chemistry teachers maintained open lines of communication, addressing any concerns, and providing necessary support to ensure the participants' comfort and satisfaction.

By implementing these measures, the study prioritized the safety, well-being, and rights of the participants, ensuring that the data gathering process was conducted in a responsible and ethical manner, even in the face of the challenges presented by the COVID-19 pandemic.

Confidentiality

Prior to the commencement of the study, all parents and students involved were thoroughly informed about their rights in accordance with the provisions outlined in

Republic Act No. 10173, also known as the Data Privacy Act of 2012. This ensured that the data gathering process adhered to legal and ethical guidelines to safeguard the privacy and confidentiality of the participants.

In accordance with Section 16 of the Data Privacy Act, which pertains to the "Rights of the Data Subject," parents and students were provided with comprehensive information regarding the collection, processing, and utilization of the gathered data. They were assured that all information, including the student's basic profile and their responses to the survey questionnaire, would be treated with the utmost confidentiality, and solely used for the stated research purposes.

To ensure the protection of the child's identity and maintain anonymity, a unique student code was assigned to each participant, replacing their actual names in all data records and analysis. This measure guaranteed that individual identities could not be linked to the collected data, thereby preserving the privacy of the participants.

In addition, the parents and students were provided with detailed information regarding their rights and the handling of their data in accordance with the Data Privacy Act of 2012. Measures such as using assigned student codes instead of names and ensuring confidentiality were implemented to protect the identity and privacy of the participants. The data was stored securely in an online database accessible only to the researcher, and retention policies were established to retain the data for up to three years before securely disposing of paper records and erasing digital files. The results of the study may be used in research presentations or publications, while the final findings will be made available to the parents, students, and other stakeholders, including the PSHS community. These steps were taken to uphold confidentiality, protect privacy, and promote transparency throughout the research process.

Data Collection Procedure

Before the conduct of the study, the researcher sent a request letter to the office of the Campus Director of the Philippine Science High School Cordillera Administrative Region campus to seek necessary permission to conduct the study. Upon approval of the request, the proposal was submitted to the Research Ethics Review Committee (RERC) for clearance. After receiving the clearance from the RERC, the orientation meeting with the parents and students was implemented. Parent consent form for parents/guardians and an Assent form for the students were secured. With the help of the PSHS staff and teachers, the survey questionnaires were implemented.

The data gathered were organized and were treated with utmost confidentiality. The use of the data collected was intended only for the purpose of the study.

Data Analysis Procedure

After the data collection phase, the gathered information was organized using tables and figures. To address the research questions, appropriate statistical analyses were conducted. Quantitative statistical computations were performed using a spreadsheet and a specific statistical software called SMARTPLS (SEM-PLS). This combination of tools enabled the researchers to accurately analyze the data, including descriptive statistics, correlation analyses, regression analyses, and structural equation modeling. The utilization of these tools facilitated the extraction of meaningful insights and the generation of robust findings for the study's objectives.

Conversion of Data to Figures

All data responses were converted to numerical values: Grade Level (9-12), gender (F= 0 or M=1), and the Likert scales (1-5) in MS EXCEL. The MS Excel file was converted into a Comma-separated value file or CSV format which separates numeral data values with commas. The CSV format is the one that can be processed by SmartPLS. Analysis of all data was done using the SmartPLS software.

Gender. The coding scheme in this study, “Female” is represented as “0” and “Male” is represented as “1”. This coding was used in order to analyze the data using numerical values.

Teacher. There were seven (7) indicators that determined the teacher factor related to the learning satisfaction of the students listed as follows: Availability for consultations, Quality of instruction, Punctuality in synchronous sessions, Timeliness in returning outputs (test results, etc.), Timeliness in giving feedback, Considerate/Understanding, and Fairness.

Each of these teacher factor indicators was rated by the students by marking the corresponding response with a 5-response Likert scale: Strongly Satisfied, Satisfied, Neutral, Unsatisfied, Strongly Unsatisfied. The Likert scale responses were assigned corresponding numerical values: 1 (Strongly Unsatisfied) to 5 (Strongly Satisfied).

Additional questions were included as part of the qualitative response of the participants. The qualitative responses were analyzed using qualitative content analysis.

Assessment. Among the assessments or activities at PSHS are the quarterly tests/exams, quizzes, essays, projects, problem sets, practical tests, laboratory activities, presentations (live or recorded video), and research papers. There were eight (8) selected indicators for the assessment factor included in the questionnaire as follows: Level of difficulty, Level of engagement, Alignment with learning objectives, Format of activities or outputs (presentations, video, reaction paper, projects, etc.), Length of activities, Instruction on the process, Number of assessments/activities, and Duration of deadlines.

Each of these assessment indicators was likewise rated by the students the same as in the teacher factor by marking the corresponding response with a 5-response Likert scale: Strongly Satisfied, Satisfied, Neutral, Unsatisfied, Strongly Unsatisfied. The Likert scale responses were assigned corresponding numerical values: 1 (Strongly Unsatisfied) to 5 (Strongly Satisfied).

Questions on assessment were included where they were asked to indicate which form of assessment they enjoyed most and which assessment they did not enjoy. Qualitative content analysis was also applied.

Learning guide. There were six (6) selected indicators for the assessment factor included in the questionnaire as follows: Clarity, Creativity, Completeness of the content, Time allotment, Modularity (bite-sized, etc.), and Quantity (no. of LGs, no. of topics, etc.), Each of these LG indicators was likewise rated by the students the same as in the teacher factor by marking the corresponding response with a 5 response Likert scale: Strongly Satisfied, Satisfied, Neutral, Unsatisfied, Strongly Unsatisfied. The Likert scale responses were assigned corresponding numerical values: 1 (Strongly Unsatisfied) to 5 (Strongly Satisfied).

Participants were asked what indicators gave a positive and negative impact on their learning satisfaction in addition to the survey which was analyzed using qualitative content analysis.

Knowledge hub (KHub). There were five (5) selected indicators for the assessment factor included in the questionnaire as follows: Accessibility, Response Time, Ease of navigation, Ease of Use, and Notification features.

Each of these KHub indicators was likewise rated by the students the same as in the teacher factor by marking the corresponding response with a 5-response Likert scale: Strongly Satisfied, Satisfied, Neutral, Unsatisfied, Strongly Unsatisfied. The Likert scale responses were assigned corresponding numerical values: 1 (Strongly Unsatisfied) to 5 (Strongly Satisfied). Similarly, additional questions were added as a qualitative part of the questionnaire.

The Overall Satisfaction of the student with the four determinants or factors (teacher, assessment, LG, and KHub) was also included in the questionnaire.

Academic self-concept (ASC). There are thirty-five (35) indicators in the ASC questionnaire (see Appendix H) in which the student rates each indicator accordingly as whether the student Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree with each statement and have corresponding numerical values of 5, 4, 3, 2, and 1, respectively. The numerical values of their responses are the ones that are encoded in the SmartPLS for correlation analysis with other determinants.

Academic motivation (AM). There are twelve (12) indicators in the AM questionnaire (see Appendix I) in which the student rates each AM indicator accordingly as whether the student Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) or Strongly Disagree (1) with each statement. The numerical values (in the parenthesis) equivalent to these responses are encoded in the SmartPLS for correlation analysis with other determinants.

Interest to learn (IL). There are eleven (11) indicators in the IL questionnaire (see Appendix J) in which the student rates each IL indicator accordingly as whether the student Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) or Strongly Disagree (1) with each statement. The numerical values (in the parenthesis) equivalent to these responses are encoded in the SmartPLS for correlation analysis with other determinants.

Mental well-being (MW). There are fourteen (14) indicators in the MW questionnaire (see Appendix K) in which the student rates each MW indicator (MW1 to MW14) accordingly as whether the student Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) or Strongly Disagree (1) with each statement. The numerical values of these responses are encoded in the SmartPLS for correlation analysis with other determinants.

The SmartPLS Software

In this study the SmartPLS software was used. SmartPLS is a software with a graphical user interface for variance-based structural equation modeling (SEM) using the partial least squares (PLS) path modeling method. It is software used when the analysis is concerned with testing a theoretical framework from a prediction perspective and in building a model relationship.

Using SmartPLS, path models with latent variables (in this study the latent variables are the determinants) were estimated or determined whether there was a significant influence of the determinants on learning satisfaction using the PLS-SEM algorithm. The software computes standard results assessment criteria (e.g., for the formative measurement models, the structural model, and the goodness of fit) and it supports additional statistical analyses such as the preliminary testing of the validity and reliability of the questionnaires based on the results/responses.

In the SmartPLS, the questionnaires were termed indicators while the determinants (teacher, assessment, LG, KHub) were assigned as latent variables.

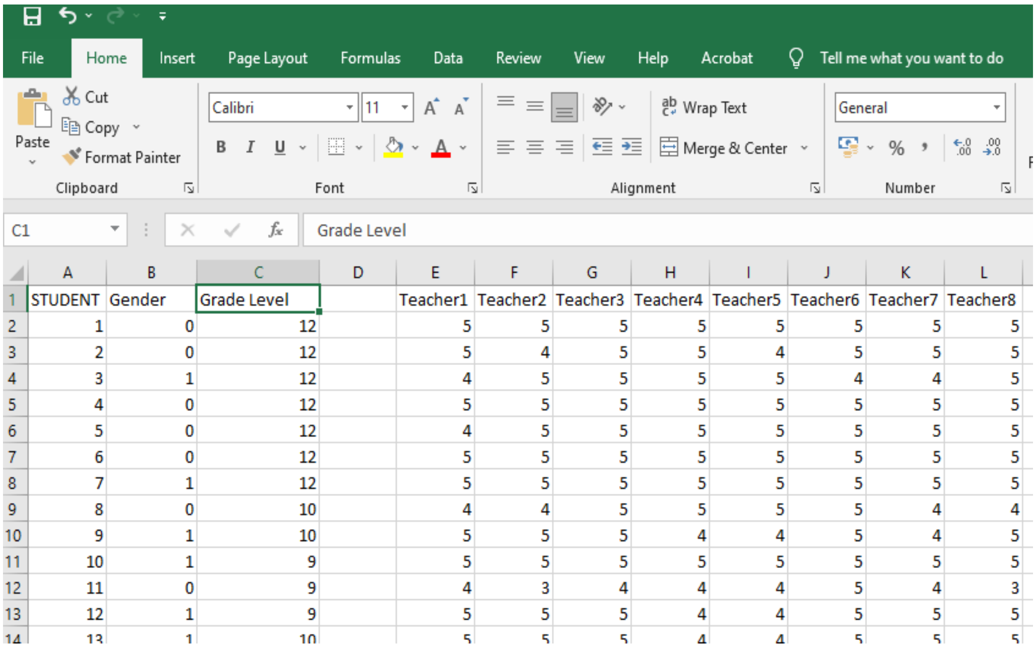
Using the PLS Algorithm, the validity, and reliability of indicators of each variable was determined by calculating Cronbach's alpha and Rho-alpha values. The numerical values of Cronbach's alpha for the validity test and Rho value (Dillon-Goldstein's rho or Jöreskog's rho) for the reliability test were computed by the software. Indicators that do not represent the variable/factor based on the Cronbach's alpha and Rho values were removed until the remaining indicators gave valid and reliable values.

The Bootstrapping PLS feature of the SmartPLS software calculates statistical p-values that were used to determine if the correlation between two variables was significant. That is if the selected direction is significant. For example, if we connect the Teacher factor towards LG and the value indicates a significant correlation, then we can conclude that the teacher influences LG and the correlation line is sustained. Otherwise, if the connection is non-significant, the connection is removed. Significant paths are kept while non-significant paths are removed until the structural model for learning satisfaction is completed. All possible connections among the variables are considered with an ultimate end on the student learning satisfaction variable.

All correlation tests were two-tailed and p-values less than 0.05 were considered statistically significant. The initial raw model considered all determinants of learning satisfaction to be directly influencing (connected) to the SLS variable. Data analysis was automatically done by the SmartPLS once the data were encoded into the software.

The SmartPLS uses multivariate analysis. The multivariate analysis takes into consideration as many factors as possible and determines important relationships and structures among multivariate. The following illustrates the step-by-step procedure for the use of the SmartPLS in treating and analyzing the data.

To analyze all data gathered, the raw data in Excel file form were converted to CSV format with a comma separating each raw data (see Figure 3.1).

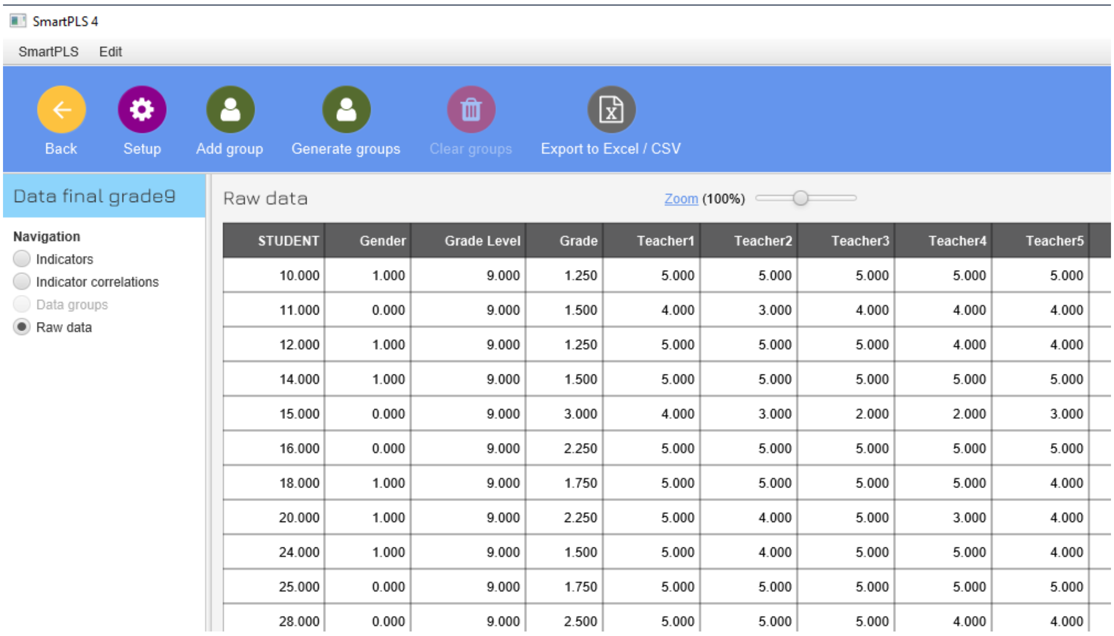


	A	B	C	D	E	F	G	H	I	J	K	L
1	STUDENT	Gender	Grade Level		Teacher1	Teacher2	Teacher3	Teacher4	Teacher5	Teacher6	Teacher7	Teacher8
2	1	0	12		5	5	5	5	5	5	5	5
3	2	0	12		5	4	5	5	4	5	5	5
4	3	1	12		4	5	5	5	5	4	4	5
5	4	0	12		5	5	5	5	5	5	5	5
6	5	0	12		4	5	5	5	5	5	5	5
7	6	0	12		5	5	5	5	5	5	5	5
8	7	1	12		5	5	5	5	5	5	5	5
9	8	0	10		4	4	5	5	5	5	4	4
10	9	1	10		5	5	5	4	4	5	4	5
11	10	1	9		5	5	5	5	5	5	5	5
12	11	0	9		4	3	4	4	4	5	4	3
13	12	1	9		5	5	5	4	4	5	5	5
14	13	1	10		5	5	5	4	4	5	5	5

Figure 3.1. Excel data showing the encoded survey responses of the respondents.

Each entry/data has already been predesignated, for example, as student number, gender, grade level, Teacher satisfaction rating (Teacher 1-8), Assessment satisfaction rating (Assess1-7), LG satisfaction rating (LG1-6), KHub satisfaction rating (KHub1-5), Overall satisfaction rating (OTeacher, OAssess, OLG, OKHub), Academic self-concept ratings (ASC1-35), Academic motivation ratings (AM1-12), Interest to

Learn ratings (IL1-11), and Mental Well-being ratings (MW1-14). The CSV raw data were imported into the SmartPLS software which reprocesses each piece of data and encodes it similarly to the original Excel file. The encoded data is shown in Figure 3.2. The data were separated by grade levels (Grades 9, 10, 11, and 12) as recommended for this study to analyze each grade level separately. The processing and analysis will be repeated identically (the same procedure) in each grade level.



STUDENT	Gender	Grade Level	Grade	Teacher1	Teacher2	Teacher3	Teacher4	Teacher5
10.000	1.000	9.000	1.250	5.000	5.000	5.000	5.000	5.000
11.000	0.000	9.000	1.500	4.000	3.000	4.000	4.000	4.000
12.000	1.000	9.000	1.250	5.000	5.000	5.000	4.000	4.000
14.000	1.000	9.000	1.500	5.000	5.000	5.000	5.000	5.000
15.000	0.000	9.000	3.000	4.000	3.000	2.000	2.000	3.000
16.000	0.000	9.000	2.250	5.000	5.000	5.000	5.000	5.000
18.000	1.000	9.000	1.750	5.000	5.000	5.000	5.000	4.000
20.000	1.000	9.000	2.250	5.000	4.000	5.000	3.000	4.000
24.000	1.000	9.000	1.500	5.000	4.000	5.000	5.000	4.000
25.000	0.000	9.000	1.750	5.000	5.000	5.000	5.000	5.000
28.000	0.000	9.000	2.500	5.000	5.000	5.000	4.000	4.000

Figure 3.2. The raw data encoded in the SmartPLS software.

To start the processing and analysis using SmartPLS, the responses/ratings to each questionnaire are further separated and designated as indicators as seen in the left panel enclosed by the red box in Figure 3.3.

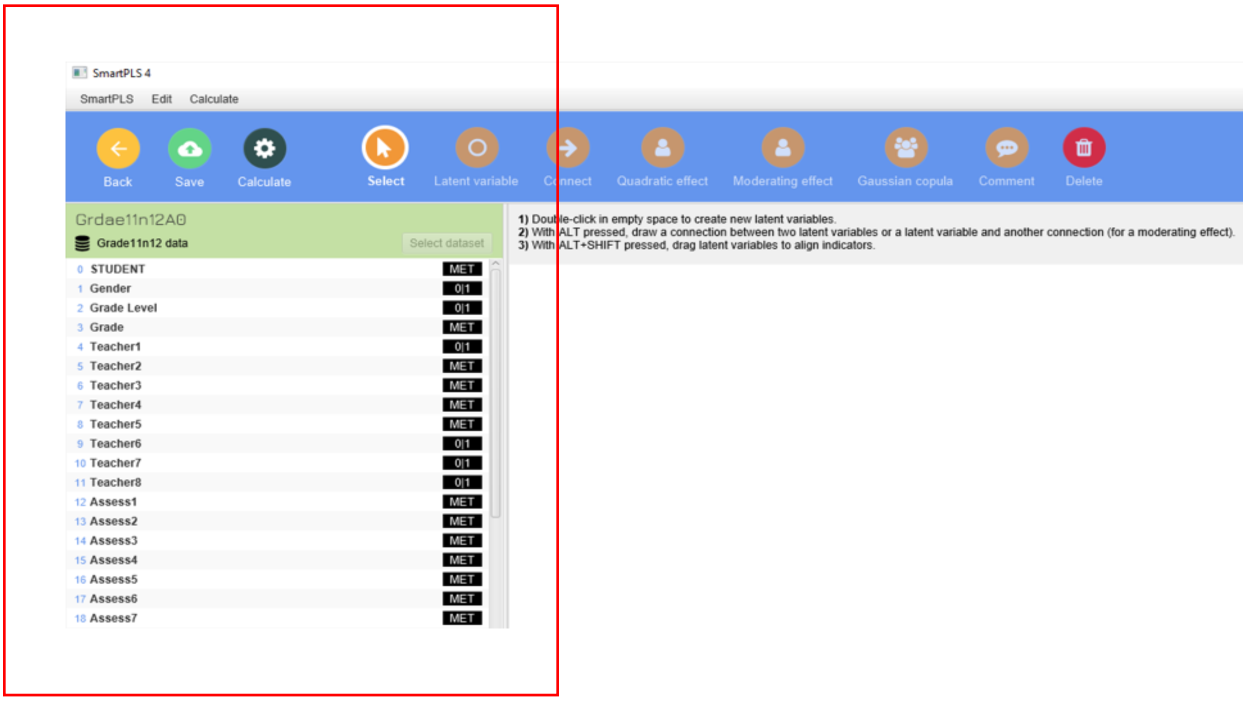


Figure 3.3. Survey questionnaires are designated as indicators in the left panel.

A latent variable can be created and then this latent variable will be defined by the indicators (ratings per questionnaire) on the left panel shown in Figure 3.4.

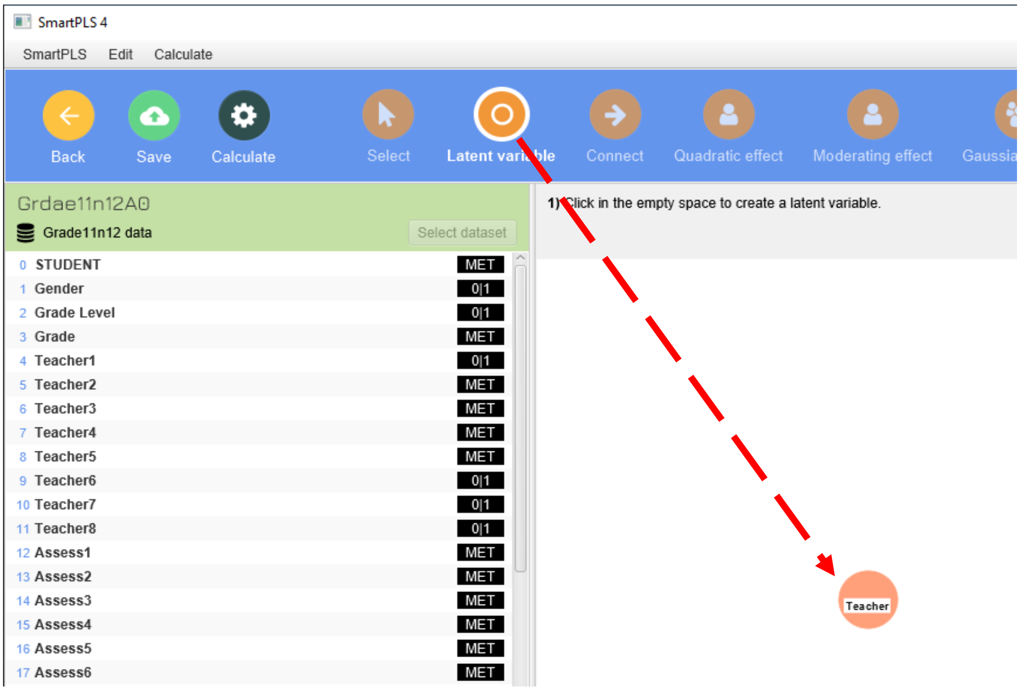


Figure 3.4. Creating a latent variable

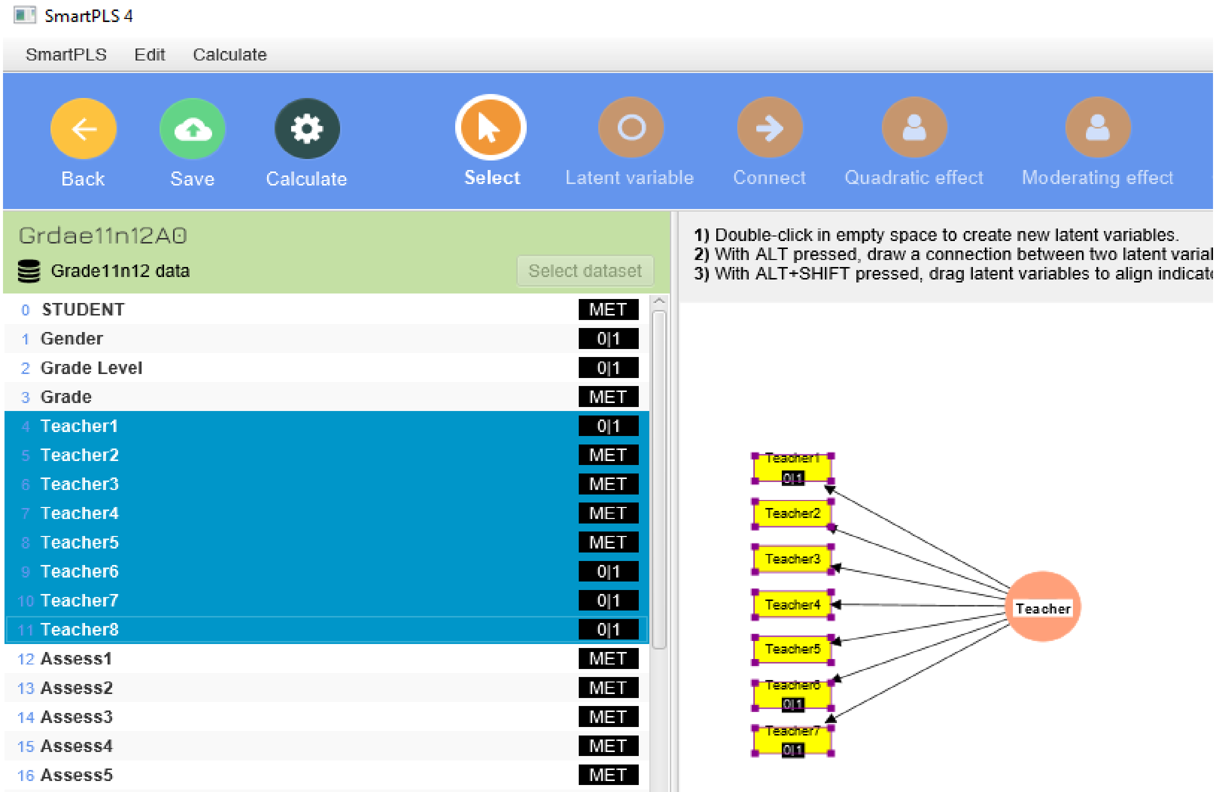


Figure 3.5. The created latent variable is defined by the indicators.

Each latent variable is defined by the indicators (yellow rectangles in Figures 3.5 and 3.6) that are designated to them. It is the latent variables that will be used to analyze and define significant paths or connections between them. To indicate that these indicators define the latent variable created, the indicators are simply clicked and dragged onto the circle, and they will be attached to the latent variable.

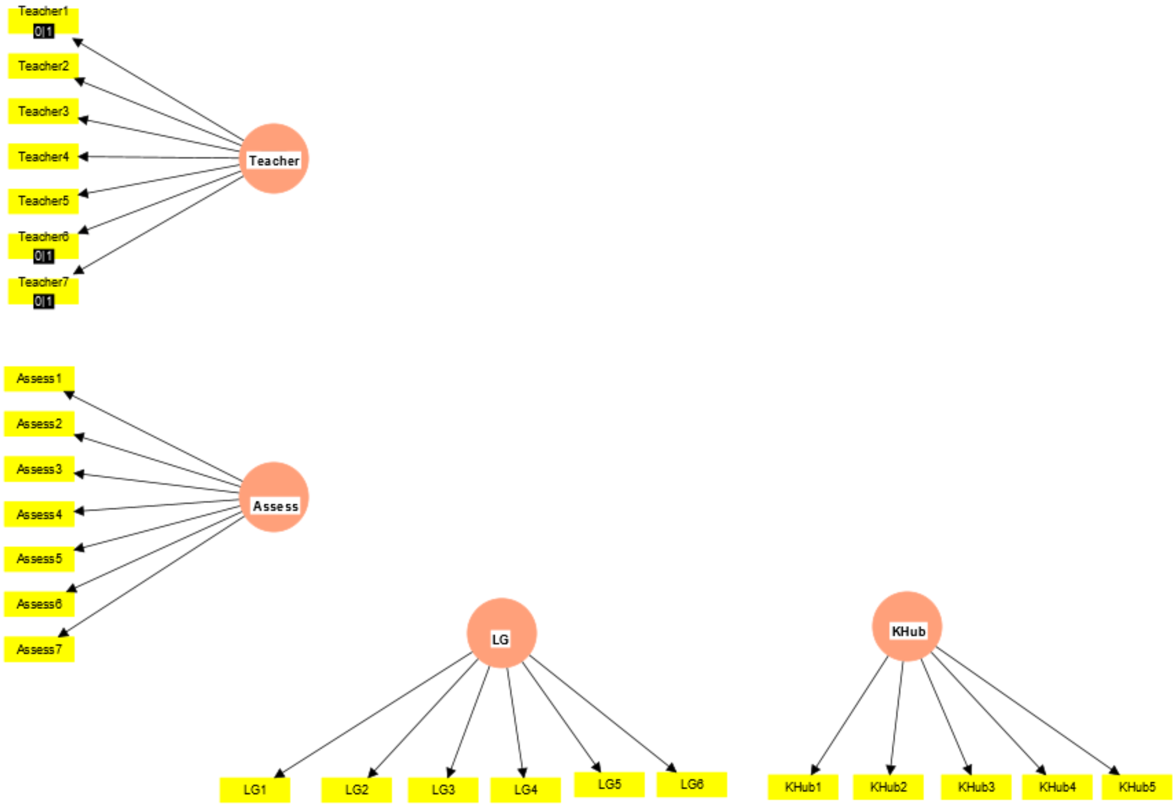


Figure 3.6. All latent variable that needs to be included in the analysis/calculation are defined.

When all desired latent variables to be tested are defined with the corresponding indicators, the latent variables are connected with lines shown in Figure 3.7. The connected lines will command the SmartPLS software to calculate p-values. Latent variables with successfully connected lines will turn blue in color. The SmartPLS will also determine significant connections at 0.05 level of significance.

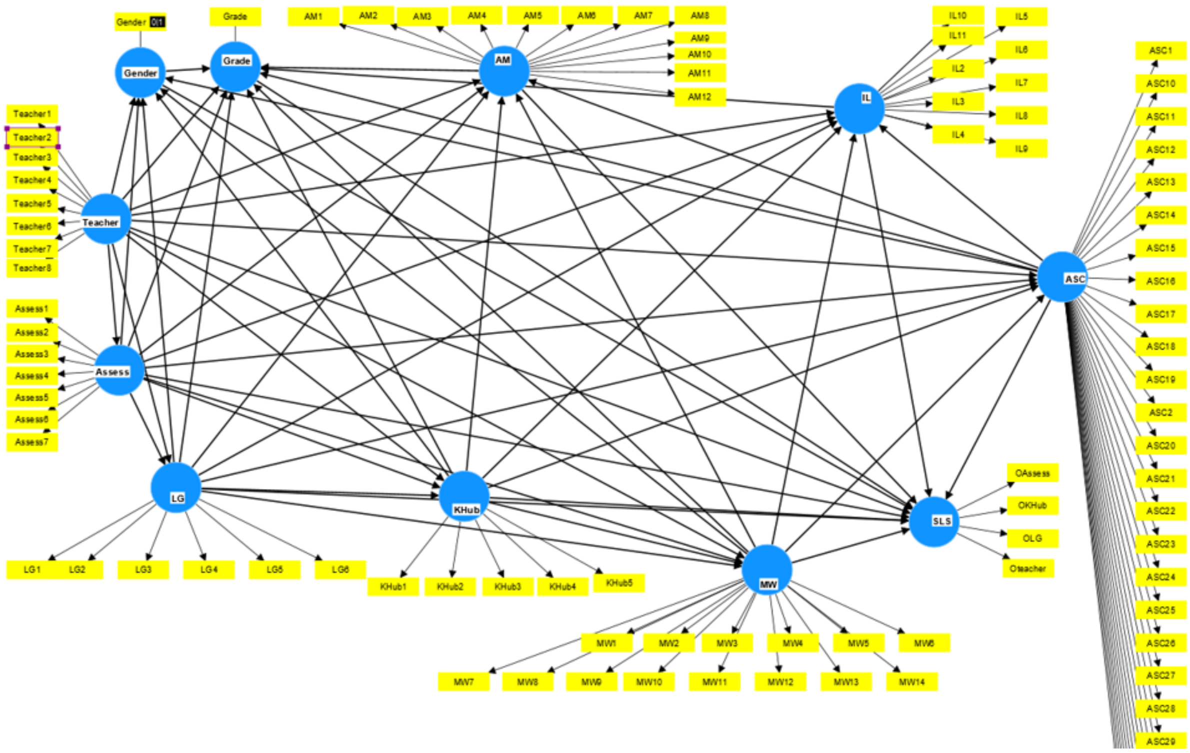


Figure 3.7. The latent variables are connected with lines to indicate that the correlations between connected variables will be calculated.

SMART-PLS is particularly useful for analyzing datasets with a large number of variables and a small sample size. The method is used to estimate the relationships between latent variables and observed variables and to identify the relative importance of different variables in explaining a given phenomenon or outcome in a short time. With 11 variables, there are 55 connections to be calculated using the software, calculations can be done in parallel due to multiple parallel processing in one computer, and calculation of all values can be done in just minutes.

For the development of the SLS and AP Models, the path Bootstrapping feature of SmartPLS was used. To illustrate the development of the SLS and AP model, the starting model has all determinants connected to the student learning satisfaction variable (as the ultimate dependent variable) shown in Figure 3.8.

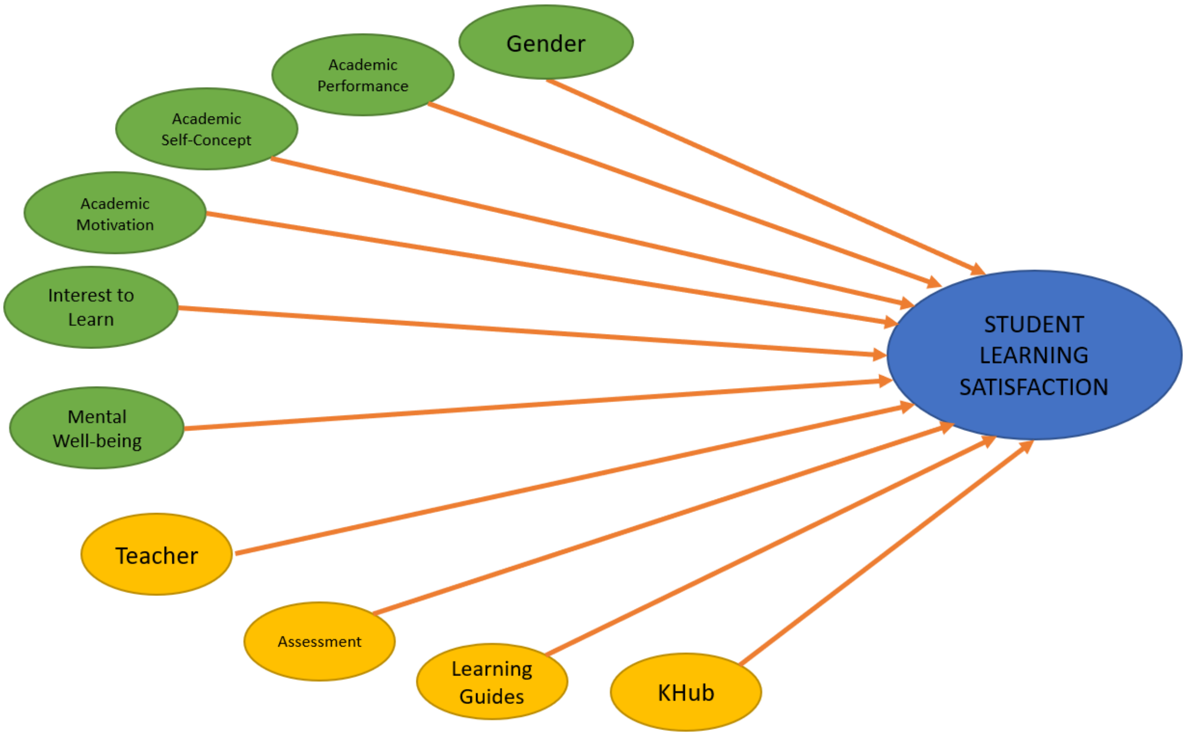


Figure 3.8. Sample of Initial SLS model showing all factors with direct correlation lines to SLS

First, all determinants were assumed to be independent of each other and the initial assumption is that each determinant impacts (directly) the SLS as shown by the solid orange lines. Additionally, it is also assumed that each determinant affects or is correlated to all the other determinants as shown by the dotted lines below (Figure 3.9).

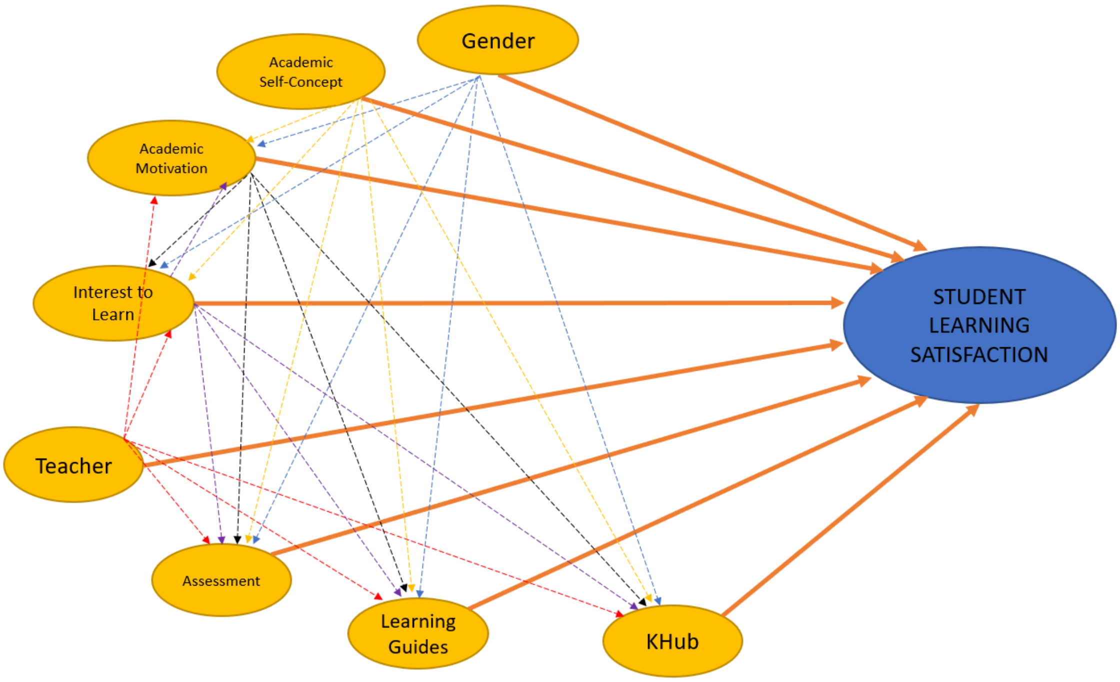


Figure 3.9. Sample SLS model showing all correlation lines.

A survey questionnaire, which the PSHS CARC Chemistry students completed, was used to indicate the student's learning satisfaction with each of these determinants. There were also separate survey questionnaires for the Academic self-concept, Academic Motivation, and Interest to learn of the students. The SmartPLS was the important tool for this study to statistically compute all data needed to determine the strength (strong or weak correlation) and direction (positive or negative correlation) of correlation. The results of these tests helped the researcher develop the final SLS and AP MODELS in this study.

The procedure is simply to remove all non-significant connections after SmartPLS has processed and computed all statistical data to determine which of the connections (correlations) made are significant. Determinants that have a significant relation to another determinant which has a direct relation to SLS and AP are said to be indirectly related to the SLS and AP. Direct and indirect lines are retained, and non-significant lines are removed. This forms the reduced SLS and AP models for this study shown in Figure 3.10 below.

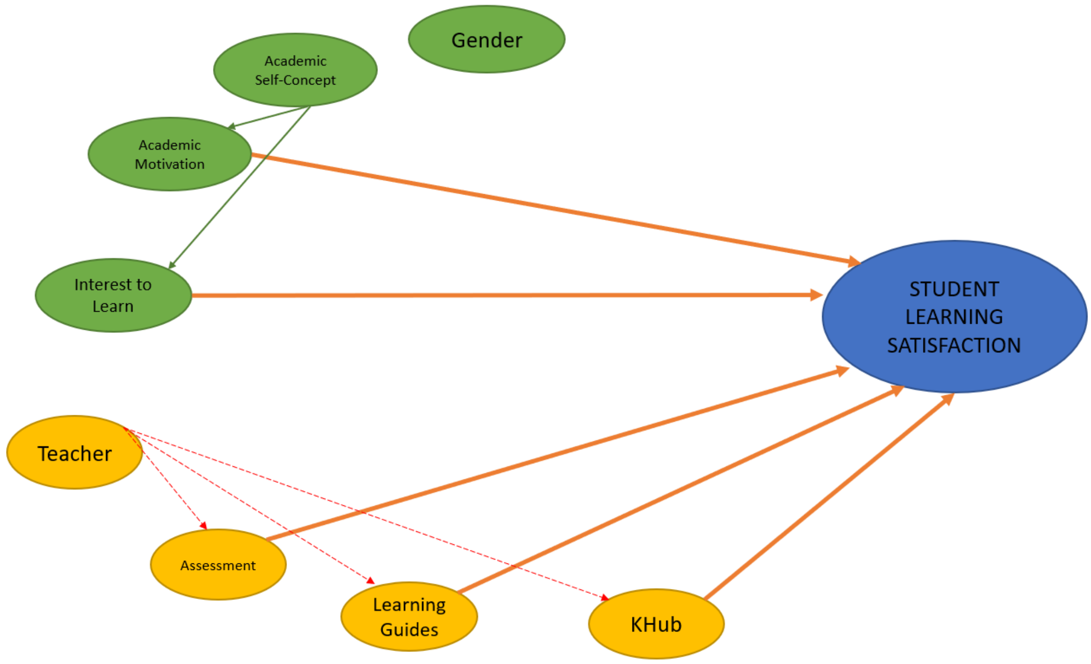


Figure 3.10. Sample Reduced SLS model showing all significant correlation lines for each determinant.

The next and final step is to re-arrange the determinants to form the final model. Based on the illustration in Figure 3.4, gender can be excluded from the final SLS model since it does not have a significant correlation with SLS or any other determinants. By removing all non-significant correlation lines from the general SLS model, the refined SLS model is obtained.

The final SLS model will be the more aesthetic, simplified, and more understandable presentation of the refined model. Sample Final Model is shown in Figure 3.11 is just a refined version of the reduced model in Figure 3.10.

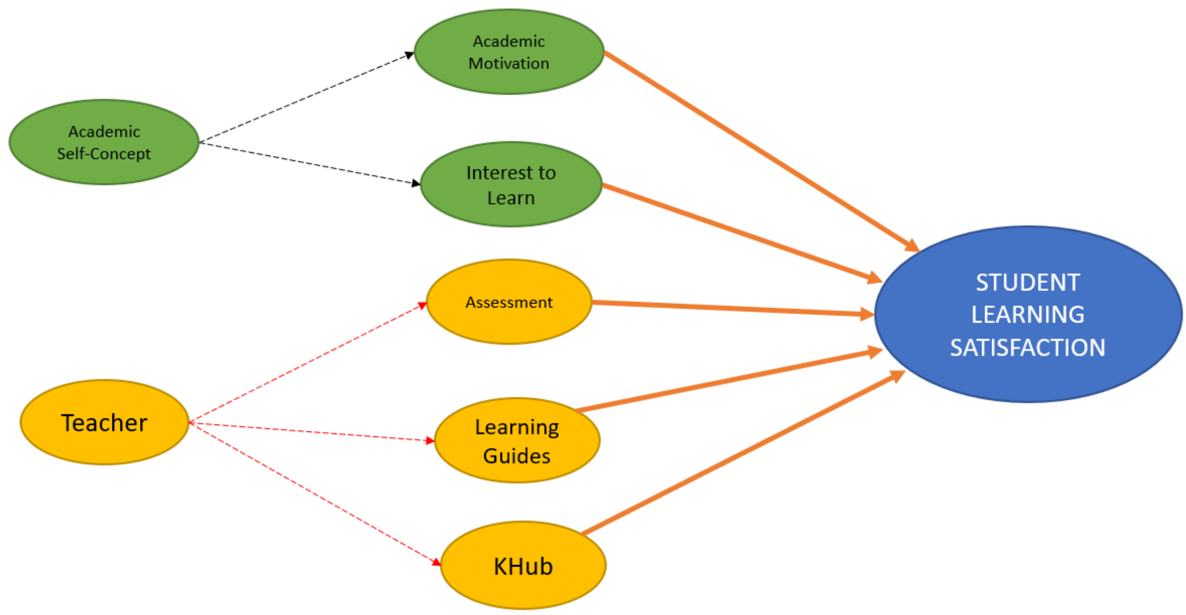


Figure 3.11. Sample of the FINAL SLS model

The Steps in Model Building for SLS and Academic Performance

The final step in this study is the model building for both SLS and AP. The survey data are processed using the SmartPLS where all significant connections (lines) in the SmartPLS graphical outputs are retained based on the calculated p-values at 0.05 level of significance. The procedure in determining the final model is illustrated in Figure 3.12.

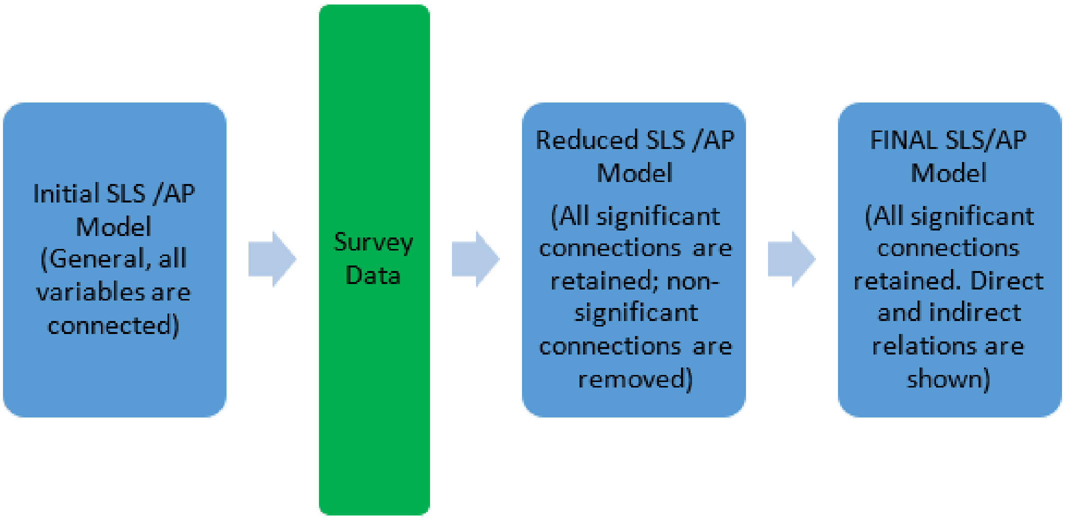


Figure 3.12. Diagram showing the development of the final SLS and AP Models to be applied for each grade level.

Further explanation of the data analysis and the development of the final SLS and AP models for each grade level and all students is discussed in chapter 4.

CHAPTER IV

RESULTS AND DISCUSSION

In this chapter, the research findings obtained from survey questionnaires are presented for the purpose of determining the influence of the determinants on student learning satisfaction (SLS) and academic performance (AP). The procedure involved analyzing the direct and indirect effects of these determinants and constructing SLS and AP models for each grade level using the SmartPLS graphical result. The data discussed below are aligned with the objectives of the study.

Influence of External and Internal Determinants to Student Learning Satisfaction

The student learning satisfaction questionnaire is a comprehensive tool designed to assess the extent of contentment or fulfillment experienced by students in relation to their academic learning. It takes into account a range of external and internal factors that can influence their overall satisfaction. In this study, the influence of both external and internal determinants on student learning satisfaction was thoroughly examined and discussed.

External determinants refer to factors that are outside the control of individual students but can significantly impact their learning experience. The determinants in this study included aspects such as the teaching, the implementation of online assessment, availability of learning resources such as the learning guides, and the use of a learning management system or KHub. By considering these external factors, the questionnaire aims to capture the broader context in which students engage in their learning activities and determine their overall satisfaction levels.

Internal determinants, on the other hand, encompass factors that are more subjective and personal to each student. These determinants may affect student attitudes and behaviors that can influence the way students perceive and experience their learning. Internal determinants in this study included factors such as academic self-concept, academic motivation, interest to learn and mental well-being. By exploring these internal factors, the questionnaire aims to uncover the unique individual perspectives that contribute to student satisfaction with their learning experiences.

By incorporating both external and internal determinants in the study, the student learning satisfaction questionnaire provided a holistic understanding of the factors that shape students' contentment and fulfillment in the academic setting. This comprehensive approach will determine the influence of these determinants in the overall learning satisfaction of students.

Teacher Satisfaction

Teachers at PSHS are not only expected to possess deep subject knowledge but also to maintain a high level of student satisfaction. The outstanding performance of all the Chemistry teachers across all grade levels, as indicated by the high ratings they received in the Teacher1 item in the questionnaire, serves as concrete evidence that PSHS is committed to achieving its objective of providing unwavering support to both teachers and students.

Table 4.1 provides a comprehensive overview of the teachers' ratings in relation to student satisfaction. The data clearly demonstrates the high level of student satisfaction at PSHS. This result confirms the study of Liu et al., (2015) and (Bao et al., 2016). According to their study, instructors' online teaching ability stands as the primary factor influencing students' learning satisfaction. Mtebe (2018) also reported that teacher quality had a positive influence on students' satisfaction. The findings also showcase the successful efforts undertaken by the school to foster an engaging and enriching learning environment, where students feel empowered and supported by their teachers.

Table 4.1
Summary Result of the Teacher Satisfaction Survey

Teacher Determinant Indicators		**Grade 9**	**Grade 10**	**Grade 11**	**Grade 12**	**ALL**
Teacher1	My teacher has a thorough knowledge of the subject content.	4.70	4.49	5.00	4.89	**4.67**
Teacher2	My teacher communicated the subject content effectively.	4.39	4.15	4.76	4.74	**4.37**
Teacher3	Punctuality in synchronous sessions	4.64	4.59	4.86	4.95	**4.68**
Teacher4	Timeliness in returning outputs	4.07	4.55	4.38	4.84	**4.40**
Teacher5	Timeliness in giving feedbacks	4.05	4.48	4.33	4.74	**4.35**
Teacher6	Considerate /Understanding	4.63	4.77	5.00	4.95	**4.77**
Teacher7	Fairness	4.57	4.60	4.95	4.95	**4.67**
Teacher8	Availability for consultation	4.46	4.51	4.90	4.89	**4.59**
	TEACHER AVERAGE	**4.44**	**4.52**	**4.77**	**4.87**	**4.56**

Rating: 5 = Strongly Satisfied, 4 = Satisfied, 3=Neutral, 2=Unsatisfied, 1=Strongly Unsatisfied

The next seven questionnaires (Teacher 2-8) are designed to assess the teacher's philosophy of teaching, attitude, and teaching performance as observed through their conduct of learning and interactions with students. The overall rating of 4.56 indicates a remarkably high level of student satisfaction. This suggests that students across all grade levels are highly satisfied with their teachers' contributions to their learning experiences. Interestingly, the satisfaction level increases as students' progress to higher grades (Grade 9 = 4.44, Grade 10 = 4.52, Grade 11 = 4.77, and Grade 12 = 4.87).

Although Grade 9 received the lowest rating of 4.44 among the grade levels, it still signifies a high satisfaction level. However, the relatively lower ratings for "timeliness of returning outputs and giving feedback" indicate that Grade 9 students have higher expectations regarding prompt responses to their learning activities. This could be attributed to their heavy reliance on the teacher for correct answers, rather than seeking answers in their textbooks or consulting their peers. Additionally, the indicators "teacher communicated the subject content effectively" and "availability for consultation" received ratings below the overall teacher satisfaction rating of 4.56, suggesting that Grade 9 students desire more interaction and communication with their teacher. This confirms the study of Bolliger and Martindale's (2004). According to them, the teacher is a significant factor in predicting student learning satisfaction. They found that strong student satisfaction is associated with the teacher's performance, particularly their availability to students and their timely responses to them.

Similarly, Grade 10 students expressed a need for increased interaction and communication with their teacher, as indicated by lower ratings for the indicators "timeliness of returning outputs and giving feedback," "teacher communicated the subject content effectively," and "availability for consultation," compared to the overall rating of 4.56.

For Grade 11 students, only the indicator "timeliness of returning outputs and giving feedback" received ratings below the overall rating of 4.56.

The findings for Grades 9, 10, and 11 align with the study conducted by Eom et al. (2006), which emphasized that students expect frequent feedback, strong content knowledge from teachers, and active facilitation of learning. Conversely, a lack of teacher interaction and ineffective facilitation of instruction can lead to student dissatisfaction with their learning experiences (Cole et al., 2014).

Grade 12 students rated all indicators higher than 4.56, suggesting that either the Grade 12 Chemistry teacher is exceptional or that Grade 12 students have developed more realistic expectations regarding their teachers' role in their learning satisfaction.

The respondents in this study emphasized the importance of the teacher's classroom management and attitude, as they significantly influence students' satisfaction with their Chemistry learning experiences. This finding supports the recommendation made by Igwe (2017) that chemistry teachers should demonstrate a positive outlook towards teaching the subject, which can foster students' positive attitudes, interest, and satisfaction with chemistry. Another study by Eom et al. (2006) also supports these findings, highlighting the critical role of teacher-student interactions in student satisfaction. The study emphasized the need for regular teacher feedback, effective facilitation of learning, and mastery of content knowledge by teachers.

Assessment Satisfaction

Assessments such as exams and quizzes have long been recognized as a significant source of stress and anxiety in the academic lives of students. However, it is important to acknowledge that assessments play a crucial role in evaluating students' learning and understanding. Consequently, it is imperative for students to find satisfaction in the assessment process. Osabutey et al. (2022) reported that when students experience satisfaction in their assessments, it can positively impact their academic performance. A study conducted by Astuti, Subagia, and Sudiana (2018) emphasized the importance of assessment in Chemistry learning. They found that assessment played a crucial role in evaluating students' progress and understanding of the subject matter.

Table 4.2 provides a summary of student satisfaction ratings regarding the assessments. Notably, the student respondents reported relatively high levels of satisfaction with their assessments, with an average rating of 4.27.

Furthermore, it is worth mentioning that there is a consistent trend of increasing assessment satisfaction ratings as students' progress from Grade 9 to Grade 11. This observation aligns with the trend observed in teacher satisfaction ratings. It implies that as students advance in their academic journey, they tend to find more satisfaction in the assessment process. This confirms the study of Bryant (2020) his findings showed that assessment satisfaction increased with age level.

Among the various aspects of assessment, Assessment 1, which measures the level of difficulty, received the lowest satisfaction rating across all grade levels. This finding is not surprising considering that Chemistry is widely regarded as one of the most challenging subjects (Cardellini, 2012). Assessments in Chemistry often require students to demonstrate not only knowledge but also their analytical and problem-solving skills. Hence, the complexity of these assessments contributes to the lower satisfaction ratings in terms of difficulty. The problem of technical issues contributes to the level of difficulty resulting in student dissatisfaction as confirmed by Noor et al. (2022).

Additionally, Xu and Lewis (2011) highlighted the significance of student attitudes in predicting their final achievement in Chemistry. According to their research, two factors are closely related to students' attitudes: intellectual accessibility and emotional satisfaction. If students perceive the learning assessment as accessible or easy, it can positively influence their overall performance in the subject.

Assessment 7 indicator (Satisfaction on the duration of deadline) garnered the highest satisfaction rating overall and in all grade levels except for Grade 9. Grade 9 students find the most satisfaction in clearer instruction (directions) of the assessment. This result is reinforced by the study of Bolliger (2006) where he emphasized the importance of feedback in the assessment results of students. He also reported that clear instructions keep the learners involved and motivated.

Table 4.2.
Summary Result of the Assessment Satisfaction Survey

Assessment Determinant Indicators		Grade 9	Grade 10	Grade 11	Grade 12	ALL
Assess1	Level of difficulty	3.91	4.07	4.10	4.37	**4.05**
Assess2	Level of engagement	3.95	4.16	4.67	4.42	**4.18**
Assess3	Format of activities or outputs	4.20	4.40	4.52	4.47	**4.36**
Assess4	Length of activities	3.93	4.19	4.62	4.37	**4.18**
Assess5	Clear Instruction on the process	4.34	4.36	4.67	4.53	**4.41**
Assess6	Number of assessment/activities	4.21	4.27	4.14	4.63	**4.28**
Assess7	Duration of deadlines	4.18	4.51	4.90	4.58	**4.46**
	AVERAGE	**4.10**	**4.28**	**4.52**	**4.48**	**4.27**

Rating: 5 = Strongly Satisfied, 4 = Satisfied, 3=Neutral, 2=Unsatisfied, 1=Strongly Unsatisfied

Learning Guides (LG) Satisfaction

The COVID-19 pandemic presented unprecedented challenges for educators, requiring them to adapt their teaching methods to ensure students could continue learning their subjects. In the absence of a physical classroom and face-to-face interaction with teachers, PSHS-CARC implemented learning guides (LGs) as a solution. LGs served as asynchronous learning materials, allowing students to learn at their own pace and convenience. However, the satisfaction ratings revealed some areas that need improvement. The summary of LG satisfaction rating is shown in Table 4.3.

Table 4.3.
Summary Result of the LG Satisfaction Survey

Learning Guide Determinant Indicators		Grade 9	Grade 10	Grade 11	Grade 12	ALL
LG1	Clarity	4.20	4.08	4.00	4.47	**4.15**
LG2	Creativity	3.73	3.84	4.33	4.37	**3.92**
LG3	Completeness of the content	4.36	4.38	4.19	4.58	**4.37**
LG4	Time allotment	3.84	4.04	4.19	4.26	**4.02**
LG5	Modularity (bite-sized, etc.)	3.98	4.03	4.29	4.58	**4.11**
LG6	Quantity (no. of LGs, no. of topics, etc.)	4.05	4.03	4.19	4.68	**4.13**
	AVERAGE	**4.03**	**4.07**	**4.20**	**4.49**	**4.12**

Rating: 5 = Strongly Satisfied, 4 = Satisfied, 3=Neutral, 2=Unsatisfied, 1=Strongly Unsatisfied

To effectively aid independent learning, LGs must be thoughtfully designed with several key characteristics. First, clarity is crucial, ensuring that directions and instructions are simple and easily understood by students. Second, completeness is vital, as LGs should provide all the necessary information required by students to grasp the lessons. Furthermore, time allotment for activities within the LGs should be reasonable and achievable within the designated time limit. The modularity and quantity of lessons should strike a balance, avoiding excessive mental strain. Lastly, creativity plays a significant role in presenting the lessons, capturing students' interest and motivating them to delve further into the content.

Although the average rating of 4.12 in Table 4.3 suggests a relatively high level of satisfaction, it is noteworthy that LGs received the lowest rating among the four external factors assessed (Teacher, Assessment, LG, and KHub). This indicates that students were least satisfied with the use of LGs in their learning. Specifically, students in grades 9 and 10 expressed a desire for more creativity in their LGs. Ansari (2011) reported similar findings, highlighting students' negative perceptions of modular learning or learning using modules/learning guides, despite its positive impact. Grade 9 students expressed dissatisfaction with the time allotment and modularity of their learning guides (LG), giving them ratings of 3.84 and 3.98, respectively. These findings aligned with Abando's study (2022), which also reported that many participants found MDL (modular distance learning) to be challenging. One of the main challenges cited by the participants was the difficulty in comprehending the content due to the structure and time constraints of the provided modules/learning guides.

It appears that students may prefer more visual illustrations and less technical discussions in their LGs to enhance their learning experience. LGs should differ from traditional textbooks and serve as user-friendly tools to guide students through the lessons effectively. Negative perceptions arise when student expectations are not met. Bordeos (2021) examined students' attitudes towards the implementation of Modular Distance Learning and found that students displayed a negative attitude towards it, perceiving it as detrimental to their learning experience and motivation. Llasos (2020) reported similar findings, where none of the respondents in her study were very satisfied with the printed modules used during the pandemic.

Sutherland et al. (2019) discovered that the difficulty of modules significantly contributed to learning dissatisfaction. If students perceive Chemistry as a challenging subject, they may find the module or LGs difficult as well, leading to dissatisfaction. Salamuddin (2021) supports the notion of the ineffectiveness of modular learning.

While the use of learning guides has been implemented to facilitate independent learning, the satisfaction ratings indicate room for improvement. Students' expectations included more visual elements and a user-friendly approach in the design of LGs. Addressing these concerns, along with considerations from related studies, can enhance the effectiveness of LGs and foster a more positive learning experience for students.

Based on Table 4.3, all grade levels are most satisfied with the completeness of the LGs which supports the report of Sutherland et al. (2019). In their study, they pointed out that the level to which a module integrates well with other components of the course is one of the most important determinants of student satisfaction. Rabajalee and Santaly (2020) reported a significant and positive relation between satisfaction and engagement of students in the use of LG.

KHub Satisfaction

KHub (Knowledge Hub), was implemented by the PSHS system as a learning management system to complement the learning guide in the online learning experience of the students. The features of KHub play a crucial role in assisting students with their online learning, which can ultimately lead to either satisfaction or dissatisfaction among students. Several factors have been identified in previous studies, such as ease of use, usefulness, information quality, system quality, service quality, and computer self-efficacy, which significantly impact student satisfaction (Ohliati & Abbas, 2019; Alkhateeb & Abdalla, 2021; Nasir et al., 2021; Nguyen, 2021).

Table 4.4 provides a summary of the student satisfaction ratings regarding the use of KHub.

Table 4.4

Summary Result of the KHub Satisfaction Survey

KHub Determinant Indicators		Grade 9	Grade 10	Grade 11	Grade 12	ALL
KHub1	Accessibility	4.50	4.51	4.57	4.68	**4.53**
KHub2	Response Time	3.98	3.84	3.90	4.42	**3.96**
KHub3	Ease of navigation	4.21	4.37	4.67	4.68	**4.39**
KHub4	Ease of Use	4.39	4.48	4.67	4.68	**4.50**
KHub5	Notification features	4.05	3.51	3.67	3.74	**3.73**
	AVERAGE	**4.23**	**4.14**	**4.30**	**4.44**	**4.22**

Rating: 5 = Strongly Satisfied, 4 = Satisfied, 3=Neutral, 2=Unsatisfied, 1=Strongly Unsatisfied

Overall, the respondents reported relatively high levels of satisfaction, with an average rating of 4.22. This finding aligns with the study conducted by Ramadania (2021). The students find KHub accessible and easy to use, as evidenced by ratings of 4.53 and 4.50, respectively. Yulyanty and Togar (2021) also confirmed that ease of use is a significant factor affecting student satisfaction. Similarly, the study conducted by G and Wijewardana (2016) supports the notion that ease-of-use influences student satisfaction. However, students seem to be relatively unsatisfied with the notification features and response time of KHub, receiving a rating of 3.73 and 3.96 respectively. Students expect immediate feedback/results of their activities via KHub (online) and appropriate notifications when such feedback/responses are available.

Similar results can be observed among students at the International University – Vietnam National University, who use their own learning management systems, Edusoft and Blackboard. Nguyen's (2021) study revealed that students are satisfied with the usefulness and quality of their LMS but express concerns regarding notifications and feedback, particularly the response time. Pham et al. (2019) stated that system quality is the most crucial aspect of overall e-learning. Positive correlations were found between overall e-learning service quality, student satisfaction, and student loyalty.

As Nguyen recommended, it is essential to target a higher satisfaction rating for the use of the KHub, even with the resumption of face-to-face classes, if it is to continue as a complementary and supplementary part of student learning.

The KHub is a powerful tool for implementing online learning, despite the challenges highlighted in reports such as limited internet access, networking issues, insufficient infrastructure for supporting learning management system (LMS) implementation, and the lack of necessary hardware and software (Alenezi, 2018). However, it is important to acknowledge that despite these barriers, students have expressed a high level of satisfaction in using the KHub.

While the mentioned challenges may exist, it is crucial to recognize the positive impact that KHub has had on students' learning experiences. By leveraging this tool, educators can deliver educational content in an online format, enabling students to access learning materials and engage in interactive activities regardless of their physical location.

Overall Student Learning Satisfaction (SLS)

To enhance overall student satisfaction in online learning, it is crucial to consider factors such as the teacher, assessment methods, learning resources, and the online platform used (KHub). Among these factors, the teacher determinant has the strongest influence on student satisfaction with a rating of 4.54. Arghode et al. (2018) confirms that learner engagement in online learning is a collaborative process involving both learners and instructors. Instructors' support and effectiveness in delivering instruction are significant predictors of student satisfaction. Rehman (2021), emphasized in his report that providing teacher support, promoting teacher-student interaction, setting clear expectations, using engaging instructional strategies, providing responsive feedback, fostering a supportive learning environment, and continuously improving teaching methods and the online learning environment are essential for enhancing student satisfaction in online learning. Similarly, Maheshwari (2021) stated in his findings that instructor’s support or teacher’s support play a vital role in maintaining student satisfaction in online learning.

The second determinant that significantly affects student satisfaction in online learning is assessment, with a rating scale of 4.26. Evaluation activities play a crucial role in aligning pedagogy, educational activities, and desired learning outcomes. They also address usability issues and benchmark achievement, providing valuable insights for continuous improvement. Assessment satisfaction provides positive feedback to students, which enhances their overall learning satisfaction.

According to by Noor et al. (2022), although students expressed satisfaction with online teaching, they perceived e-learning tools as inadequate for achieving their learning outcomes and objectives. Students faced challenges with comprehending online lectures, and their dissatisfaction extended to the online assessment methods. Furthermore, technical issues adversely impacted students' performance.

Findings by Slack and Priestley (2022) suggest that while some students perceive online learning and assessment to require more effort compared to traditional methods, others appreciate the increased flexibility offered by online approaches. It is essential to consider the diverse needs and preferences of students when designing and implementing online assessments.

Guru (2021) reports that online assessment increases student satisfaction due to several reasons. Firstly, prompt results alleviate students' anxiety, and instant feedback supports formative assessment. Immediate feedback allows students to analyze their performance and make necessary adjustments to improve their learning outcomes. Additionally, online assessments offer the advantage of being conducted anytime and anywhere, benefiting students who require flexibility in their study schedules. Students often find online assessments interactive and enjoyable, contributing to a positive learning experience.

Lastly, taking exams in a comfortable environment, such as their own homes, can enhance student satisfaction. Being in a familiar and relaxed setting can positively impact students' performance and overall learning satisfaction.

The Learning Guide and KHub determinants has identical satisfaction rating of 4.18. Though students find them both helpful in online learning, features of these tools may affect their learning satisfaction.

Pham et al. (2021) reported that the Learning Management System must consistently demonstrate the ease of use, accessibility, and speed of transmission because it plays a crucial role in the learning process. The enhanced adaptability of online learning can be attributed to the improved accessibility, leading to positive outcomes. If KHub features is not improved to meet its expected use, student learning satisfaction decreases.

Another challenge of online learning that many students face is the struggle to focus for long durations on screen during synchronous classes (Kumar, 2021). A plethora of distracting content available online may or may not help students. Technological, literal and technical competency affect student satisfaction in using the LMS/KHub (Barrot et al., 2021).

Sutherland et al. (2019) conducted a study identifying key factors that drive overall student satisfaction in an online learning environment. These factors include the helpfulness of lectures and seminars, the degree of direct student-teacher contact time, the integration of modules with other course elements, the usefulness of supporting online materials, and the appropriateness of summative assignments.

The helpfulness of lectures and seminars, which involve direct student-teacher contact time, was found to be the most important determinant of student satisfaction. This highlights the significance of engaging and informative instructional sessions that promote active student participation and interaction.

The degree to which a module integrates well with other elements of the course also impacts student satisfaction. When the content and activities within a module are effectively aligned with the overall course structure and objectives, students experience a sense of coherence and relevance, enhancing their learning experience.

The usefulness of supporting online materials is another factor highlighted by the study. Providing comprehensive and well-organized resources such as readings, videos, interactive exercises, and supplementary materials can greatly support student learning and satisfaction.

Sutherland et al. (2019) noted that the student-teacher contact time is the most critical factor of satisfaction. Students give high regard to their teacher's performance more than anything. Another important finding in their study was that LG or module difficulty was a cause of dissatisfaction. Another finding emphasized that feedback on formative assignments appears as a weaker driver of overall satisfaction which confirms the result of this study.

Shown in Table 4.5 are the overall satisfaction ratings of the students per grade level. The last column shows the mean satisfaction rating by all students (all grade levels).

Table 4.5
Summary Result of the Overall Student Learning Satisfaction Survey

OVERALL SATISFACTION		**Grade 9**	**Grade 10**	**Grade 11**	**Grade 12**	**ALL**
OTeacher	Overall Teacher satisfaction	4.39	4.47	4.95	4.79	**4.54**
OAssessment	Overall Assessment satisfaction	4.13	4.31	4.29	4.47	**4.26**
OLearningGuide	Overall Learning Guide satisfaction	4.23	4.01	4.29	4.58	**4.18**
OKHub	Overall KHub satisfaction	4.20	4.11	4.14	4.42	**4.18**
	AVERAGE	**4.24**	**4.22**	**4.42**	**4.57**	**4.29**

Rating: 5 = Strongly Satisfied, 4 = Satisfied, 3=Neutral, 2=Unsatisfied, 1=Strongly Unsatisfied

Table 4.5 simply confirms the results as discussed in the survey with Teacher, Assessment, LG and KHub satisfaction in the previous sections. Regarding their learning, the students find the highest satisfaction with their teacher's performance. Again, the two important tools (LG and KHub), proposed to help the students in their learning, had the lowest satisfaction ratings with identical 4.18.

Summary of the Qualitative Part of the SLS Survey

The SLS survey included questionnaires on the positive and negative impacts of the Learning Guide (LG) related indicators, Knowledge Hub (KHub) related indicators, Teacher related indicators, and Assessment related indicators (See Appendix R).

The qualitative part of the study is analyzed and summarized to validate the quantitative results of this research. This section summarizes the positive and negative effects of the external determinants based on the students' responses on the survey questionnaire.

Learning Guide (LG)

A. Positive Influencers

The LG indicators that positively affect learning satisfaction were identified across different grade levels. Clarity of instructions, completeness, and creativity were key factors for all grade levels. Illustrations, visual aids, and online links in LG modules were seen as signs of creativity. Modularity of LG discussions was appreciated by Grade 11 students. Grade 12 students found the completeness of LG material important.

B. Negative Influencers:

For Grade 9 and 10 students, time allotment for lengthy LG activities negatively affected satisfaction. The quantity of LG modules overwhelmed students in Grade 10 and 11. Grade 12 students complained about incomplete LG information and time-consuming modules.

Knowledge Hub (KHub)

A. Positive Influencers:

KHub's accessibility, ease of use, and navigation were praised by all grade levels. The notification feature for recording activities positively impacted learning satisfaction.

B. Negative Influencers:

Across all grades, slow response time, delayed notifications, and occasional loading issues were common complaints. Connectivity problems hindered KHub experience, leading to dissatisfaction.

Teacher

A. Positive Influencers:

Teacher's mastery of the subject, enthusiasm, and effective communication positively influenced learning satisfaction. Considerate teachers who understood student deadlines and needs were appreciated. For Grade 12 students, clear instructions and being considerate were highlighted.

B. Negative Influencers:

Delayed return of assignments/feedback and unresponsiveness negatively impacted satisfaction. Grade 10 students disliked fast pacing, unclear lessons, and lack of punctuality.

Assessment

A. Positive Influencers:

Students appreciated reasonable assessment duration, clear instructions, and engaging formats. Flexibility in deadlines and fun, relevant discussions were valued.

B. Negative Influencers:

Grade 9 students found assessments too difficult and time-consuming. Unclear instructions and time-consuming assessments affected Grade 10 satisfaction. Grade 11 students struggled with both excessive and insufficient assessment activities. Grade 12 students complained about non-traditional assessment formats.

In general, the qualitative results from the survey highlighted the importance of clear instructions, reasonable time allocation, effective communication, and flexibility in teacher-student interactions, learning materials, and assessment methods. Students' satisfaction was affected by these factors in both positive and negative ways, underlining the need for balanced and well-designed learning experiences.

The Learning Guide emerged as the main determinant that might either elevate or hinder student satisfaction. The Knowledge Hub, as a source of information, demonstrated its capacity to influence learning satisfaction, serving as a dynamic platform capable of both inspiring and challenging learners.

Equally significant, the role of teachers in shaping student learning satisfaction was undeniable. Their competence, engagement, and approach played a substantial part in either fostering a positive and motivating learning environment or potentially dampening the spirit of the students. Furthermore, the Assessment processes, while necessary for gauging progress, also revealed their capacity to sway student satisfaction, with constructive assessment methods contributing positively and poorly structured assessments eliciting negativity.

INTERNAL DETERMINANTS

Survey questionnaires were developed to assess the internal determinants and their impact on students' perspective and feelings regarding the implementation of online learning. The study aimed to investigate how these determinants, namely Academic Self-concept (ASC), Academic Motivation (AM), Interest to Learn (IL), and Mental Well-being (MW), influenced students' learning satisfaction. The survey questionnaires underwent rigorous evaluation to ensure their reliability and validity, including content validity and Cronbach's alpha analysis.

The results of the content validity and Cronbach's alpha analysis can be found in Tables 3.3 and 3.4, respectively.

Academic Self-Concept (ASC)

How the students perceive themselves in their learning is a very important aspect of how a student would actually learn. Learning starts with a correct mindset. A positive self-concept will result in better learning. A negative self-concept on the other hand will spell failure in learning even before the learning process is started.

Ghazvini (2011) research findings showed a significant correlation between academic self-concept and academic performance. Academic self-concept positively influences the general performance of students. Table 4.6 shows the mean scores of each ASC questionnaire per grade level and for all students. These mean scores are the average values of the students' responses based on the 5-point Likert Scale.

Table 4.6
Academic Self-Concept (ASC) Survey Ratings

ACADEMIC SELF CONCEPT		Grade 9	Grade 10	Grade 11	Grade 12	ALL
ASC1	If I try hard enough, I will be able to get good grades	4.36	4.30	4.67	4.74	**4.41**
ASC2	I try hard and I do well in school.	3.77	3.79	4.19	4.21	**3.88**
ASC3	I study hard so I expect to get a high score on the exam.	3.77	3.48	4.10	3.89	**3.70**
ASC4	All in all, I feel I am a capable student.	3.68	3.66	4.05	4.26	**3.78**
ASC5	I do well in my courses given the amount of time I dedicate to studying	3.84	3.67	4.24	4.47	**3.89**
ASC6	I am satisfied with my grades in high school.	3.77	3.67	4.10	4.21	**3.82**
ASC7	I view myself as intelligent.	3.09	3.30	3.38	3.74	**3.29**
ASC8	My courses are very easy for me.	2.79	2.89	2.95	3.11	**2.89**
ASC9	I feel like dropping out of school	2.48	2.21	1.95	1.58	**2.20**
ASC10	My classmates do better in school than I do.	3.84	3.84	3.71	3.11	**3.74**
ASC11	I am a good student.	3.50	3.48	3.81	4.16	**3.60**
ASC12	I feel High school is too difficult for me.	2.89	2.78	2.71	1.89	**2.71**
ASC13	All in all, I am proud of my grades in High school.	3.45	3.60	3.71	4.21	**3.63**
ASC14	I feel confident while taking a test.	3.00	3.11	3.14	3.21	**3.09**
ASC15	I feel capable of helping others with their class work.	3.45	3.33	3.95	3.95	**3.51**
ASC16	I feel teachers' standards are too low for me.	2.39	2.27	2.14	2.05	**2.27**
ASC17	It is easy for me to keep up with my classwork.	3.16	3.14	3.52	3.79	**3.27**
ASC18	I am satisfied with the class assignments that I turn in.	3.50	3.42	3.62	3.89	**3.53**
ASC19	I feel like I accomplished a lot.	3.23	3.15	3.48	3.68	**3.28**

ASC20	I feel I study enough before a test.	3.21	3.00	3.38	3.32	**3.15**
ASC21	Exams are easy for me	2.61	2.59	2.62	2.53	**2.59**
ASC22	I have doubts that I will do well in my subjects.	3.82	3.71	4.05	3.32	**3.75**
ASC23	I have a hard time getting through school.	3.21	2.95	3.10	2.68	**3.02**
ASC24	I am good at scheduling my study time.	2.88	2.70	2.95	2.84	**2.80**
ASC25	I have a clear sense of my academic goals.	3.41	3.47	3.71	3.74	**3.51**
ASC26	I'd like to be a better student than I am now.	4.77	4.67	4.86	4.53	**4.71**
ASC27	I get encouraged about school.	3.64	3.55	3.86	4.05	**3.67**
ASC28	I enjoy doing my homework.	3.02	3.11	3.05	3.26	**3.09**
ASC29	I consider myself a very good student.	2.89	3.07	3.43	3.58	**3.11**
ASC30	I get the grades I deserve in my courses	4.04	3.70	4.05	4.42	**3.93**
ASC31	I study as much as I should	3.27	3.15	3.29	3.53	**3.25**
ASC32	I feel that I am better than the average high school student.	2.80	3.08	3.05	3.16	**2.99**
ASC33	In my courses, I feel that my classmates are better prepared than I am.	3.98	3.99	4.10	3.47	**3.94**
ASC34	I feel that I have the necessary abilities for my subjects in high school.	3.43	3.45	4.00	3.79	**3.55**
ASC35	I have very good study habits.	2.82	2.66	2.95	3.11	**2.80**
	AVERAGE	**3.47**	**3.31**	**3.54**	**3.53**	**3.38**

Rating: 5 = Strongly Agree, 4 = Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree

The Academic self-concept result showed that the PSHS student respondents exude optimism in their academic self-concept. Among those with high ratings across all grade levels are ASC26 (I'd like to be a better student than I am now) and ASC1 (If I try hard enough, I will be able to get good grades) with ratings of 4.71 and 4.41, respectively.

On the other hand, ASC24 (I am good at scheduling my time) and ASC35 (I have a very good study habit) had relatively low ratings of 2.80. In other words, the students do not find themselves having the self-discipline to schedule their study time and have good study habits). They may need intervention in this area, a workshop session regarding time management is recommended to enhance the self-concept of the students on this matter.

This study will exclude the questionnaires with contra-positive indications to the Academic Self-concept (ASC 9, 10, 12, 16, and 33). This is to be consistent with the expectation that a high score means a high ASC rating. The Contra-positive statements, like ASC9 (I feel like dropping out of school.) will yield a very low score (2.20) but this is a good indication of high academic self-concept. It means that the respondents disagree that they want to drop out or stop learning. On the contrary, the low score/rating affirms their desire to continue learning. Hence, for the statistical calculations and analysis, the contrapositive statements will not be included.

Academic Motivation (AM)

Table 4.7 presents the mean rating of the students on their academic motivation based on the 5-point Likert Scale. While all grade levels are motivated by earning high grades in Chemistry (AM1 with the highest rating of 4.49), they appear to be "demotivated" by the problem-solving requirement of Chemistry courses. AM6 has the lowest rating of 2.47 which means that they disagree with the statement that they can solve a question or problem in Chemistry. In other words, their difficulty in solving problems decreases their academic motivation toward Chemistry. This may lead also to their low rating of 2.56 in AM10, being competitive with other students in Chemistry.

Table 4.7
Academic Motivation (AM) Survey Ratings

ACADEMIC MOTIVATION		Grade 9	Grade 10	Grade 11	Grade 12	ALL
AM1	I want to have high grades in Chemistry.	4.64	4.22	4.81	4.68	**4.49**
AM2	I like it when my classmates listen to me when I discuss Chemistry.	3.55	3.27	3.67	4.00	**3.50**
AM3	I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry.	3.98	3.66	4.29	4.47	**3.93**
AM4	I know how to get the right resources to solve a question or problem in Chemistry.	3.70	3.32	3.81	3.89	**3.57**
AM5	I experience satisfaction in learning new things in Chemistry.	4.02	3.84	4.86	4.32	**4.08**
AM6	I believe I can solve any Chemistry question or problem.	2.41	2.38	2.95	2.47	**2.47**
AM7	I experience pleasure in learning new things in Chemistry	3.93	3.70	4.52	4.32	**3.95**
AM8	After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it.	3.21	2.84	2.90	3.11	**3.00**
AM9	I feel smart when talking about my ideas that most people don't know about Chemistry.	3.20	3.03	3.52	3.42	**3.19**
AM10	I like being competitive with other students in my Chemistry class.	2.71	2.51	2.48	2.42	**2.56**
AM11	I want to have a career in Chemistry.	2.39	2.58	2.95	2.95	**2.60**
AM12	Most of the time my efforts are rewarded.	3.48	3.33	3.52	3.74	**3.45**
	AVERAGE	**3.44**	**3.22**	**3.69**	**3.65**	**3.40**

Rating: 5 = Strongly Agree, 4 = Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree

PSHS students have been observed to be competitive in their academics in general but maybe not in Chemistry as the result of this survey shows. Another implication is a demotivation of the students to have a career in Chemistry (AM11) which registers a low rating of 2.60. The students do not find motivation in having a career in Chemistry and hence the low motivation to learn.

Foong et al. (2021) believed that one of the reasons for dropouts among chemical engineering students is the lack of motivation. Their study surveyed the variations in chemical engineering students' motivation over six months and evaluated the relationship between motivation and academic performance. Findings showed that motivation of the students remained unchanged for 6 months. The students demonstrated the least motivation, but they were most motivated “to have a good life later on.” The study of Foong et al. (2021) confirms the result of this study that Chemistry students are least motivated but high in self-concept believing that they will not drop out of class. Students did not develop higher motivation from Grade 9 to Grade 12 as shown in the result of their AMS hence there is a need for motivation enhancement.

Hanna (2022) used a desk study review strategy where pertinent empirical literature was studied to categorize main themes and determine knowledge gaps. She reported that the perception of students of chemistry determines their performance in tests and that most students do not exhibit a positive outlook toward chemistry. Furthermore, the findings showed motivational strategies can help students to increase their academic performance in Chemistry.

Interest to Learn (IL)

Interest in learning is a powerful driving force that fuels individuals' motivation to acquire knowledge and skills. It is a personal inclination and desire that promotes active engagement in the learning process. When someone is genuinely interested in a subject, they exhibit enthusiasm, curiosity, and a willingness to invest time and effort to expand their understanding. This intrinsic motivation not only enhances the learning experience but also improves knowledge retention and application.

Various factors contribute to the development of interest in learning. Personal experiences and prior knowledge play a crucial role in shaping individuals' interests and preferences. Curiosity about a particular subject or its relevance to personal goals and aspirations can also influence one's interest. Recognizing and harnessing these factors can help educators create engaging learning experiences that cater to students' individual interests.

Research conducted by Hsu (2017) focused on exploring the relationship between students' satisfaction and their interest in learning using a web-based platform. The study found a positive and significant correlation between satisfaction and learning interest, suggesting that when students are satisfied with their learning experiences, their interest in the subject matter is heightened.

The summary of the mean rating of the students on their interest to learn based on the 5-point Likert Scale is shown in Table 4.8.

Table 4.8.
Interest to Learn (IL) Survey Ratings

INTEREST TO LEARN		Grade 9	Grade 10	Grade 11	Grade 12	ALL
IL1	I generally have fun when I am learning Chemistry topics	3.54	3.42	3.95	4.37	**3.63**
IL2	I am happy solving Chemistry problems	3.25	3.19	3.52	3.79	**3.32**
IL3	I enjoy acquiring new knowledge in Chemistry	3.98	3.81	4.43	4.42	**4.01**
IL4	I am interested in learning about Chemistry	3.71	3.70	4.24	4.21	**3.83**
IL5	Learning Chemistry is important to me.	3.59	3.48	3.76	3.95	**3.60**
IL6	I find many applications of Chemistry in real life.	3.64	3.71	4.38	4.42	**3.85**
IL7	I really like Chemistry as a subject.	3.50	3.27	4.10	4.16	**3.55**
IL8	I want to discover new things in Chemistry I have never known before.	3.84	3.63	4.29	4.11	**3.83**
IL9	I like to read in advance before a Chemistry topic is discussed in class.	3.16	2.84	2.86	3.05	**2.97**
IL10	I would always strive to know the physical meaning of Chemistry equations.	3.25	2.99	3.29	3.11	**3.12**
IL11	I want to do research in Chemistry.	3.13	2.88	2.95	3.11	**2.99**
	AVERAGE	**3.51**	**3.36**	**3.80**	**3.88**	**3.52**

Rating: 5 = Strongly Agree, 4 = Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree

At all grade levels, students displayed enthusiasm for acquiring new knowledge in Chemistry (IL3), demonstrating a positive attitude towards learning. Nevertheless, the data also uncovered areas where students showed less inclination: reading in advance before a Chemistry topic is discussed in class (IL9) and engaging in research activities related to Chemistry (IL11). These aspects received the lowest ratings, with scores of 2.97 and 2.99, respectively.

This points to potential areas for improvement, where educators can concentrate their efforts on fostering research skills and cultivating a deeper interest in Chemistry beyond basic knowledge acquisition. By creating opportunities for students to engage in research and inquiry-based learning, they can develop a stronger connection with the subject and its real-world applications.

Similarly, encouraging students to read in advance is a matter that educators must address. Providing them with pre-class reading materials and emphasizing the benefits of preparatory reading can enhance classroom discussions and boost students' understanding and participation.

Further support for the importance of interest in learning comes from the study conducted by Huang (2021). The research demonstrated that interest in a course was a more accurate predictor of future choices than students' grades. This highlights the significance of nurturing and sustaining students' interest throughout their learning journey.

The average rating of 3.52 across all grade levels indicates a relatively low level of interest in learning Chemistry. To address this, educators and teachers may need to invest additional effort to engage students and pique their interest in the subject. A study by Schukajlow and Krug (2014) revealed a positive correlation between students' performance test scores and their reported interest and enjoyment. Therefore, by creating stimulating and interactive learning experiences that encourage higher academic performance, teachers can help foster students' interest and enjoyment in Chemistry.

In a study conducted by Igwe (2017), it was discovered that there is a strong positive correlation between students' interest in Chemistry, their attitude towards the subject, and their achievement in Chemistry, all of which are influenced by the classroom management attitude of the teacher. This finding highlights the importance of Chemistry teachers adopting effective teaching strategies to engage students in the subject.

To make their teaching more engaging, Chemistry teachers should consider incorporating practical activities, fostering a cordial classroom environment, and utilizing instructional materials. By integrating hands-on experiments and demonstrations, teachers can provide students with opportunities to actively explore and apply their knowledge, enhancing their interest in Chemistry. Additionally, creating a welcoming and supportive classroom atmosphere promotes positive student-teacher relationships, which can further contribute to students' interest in the subject.

It is crucial for Chemistry teachers to demonstrate a positive attitude towards the teaching of chemistry. By expressing enthusiasm, passion, and a genuine interest in the subject matter, teachers can inspire and motivate students to develop a similar attitude towards Chemistry. This positive approach is instrumental in fostering students' interest, which, in turn, leads to better achievement in the subject.

Supporting the significance of interest in Chemistry, a study conducted by Surya and Arty (2020) examined the interest levels of 61 high school students. The results indicated that 29.2% of the students exhibited high interest, 67.2% showed moderate interest, and only 3.3% had low interest in Chemistry. Furthermore, the study found that female students displayed a higher level of interest compared to their male counterparts. Based on these findings, the researchers recommended that teachers and educators focus on enhancing student interest, as it has a significant impact on the overall learning process.

Interest in learning is a fundamental driver of motivation, active engagement, and knowledge acquisition. It plays a crucial role in shaping students' academic choices and personal development. Recognizing the factors that influence interest and employing effective teaching strategies can enhance students' engagement and promote a deeper understanding of the subject matter. With a concerted effort from educators and students alike, it is possible to cultivate a stronger interest in learning Chemistry and unlock the intellectual growth and personal development that accompanies it.

Mental Well-being (MW)

Enhancing the mental well-being of learners is crucial, especially in the context of the pandemic, where students face unique challenges in their learning. The mental well-being of learners refers to their ability to cope with the demands of learning under pandemic conditions and their capacity to concentrate on their studies.

The study by Ranadewa (2021) showed that mental well-being affects learners' satisfaction. The mental well-being of the learner can be defined as the level to which learners are mentally able to deal with their learning in the pandemic conditions and their ability to concentrate on their learning. Table 4.9 shows the mean score of the students per mental well-being survey question based on the 5-point Likert Scale. The fact that almost all mean scores are below 4.0 shows an alarming signal that the students' mental well-being should be a concern while they are in the online learning process.

Table 4.9
Mental Well-Being (MW) Survey Ratings

	MENTAL WELL-BEING	**Grade 9**	**Grade 10**	**Grade 11**	**Grade 12**	**ALL**
MW1	I've been feeling optimistic about the future	3.23	3.21	3.62	3.95	**3.35**
MW2	I've been feeling useful	3.21	3.23	3.52	3.95	**3.34**
MW3	I've been feeling relaxed	3.11	3.37	3.14	3.89	**3.31**
MW4	I've been feeling interested in other people	3.39	3.52	3.71	3.95	**3.55**
MW5	I've had energy to spare	3.34	3.30	3.43	3.79	**3.38**
MW6	I've been dealing with problems well	3.11	3.22	3.62	3.53	**3.27**
MW7	I've been thinking clearly	3.09	3.27	3.24	3.58	**3.24**
MW8	I've been feeling good about myself	3.07	3.40	3.00	3.84	**3.29**
MW9	I've been feeling close to other people	3.66	3.55	3.29	3.84	**3.59**
MW10	I've been feeling confident	3.20	3.27	3.10	3.47	**3.25**
MW11	I've been able to make up my own mind about things	3.50	3.44	3.52	3.95	**3.53**
MW12	I've been feeling loved	3.77	3.78	3.67	4.16	**3.80**
MW13	I've been interested in new things	3.88	4.08	4.19	4.00	**4.02**
MW14	I've been feeling cheerful	3.61	3.55	3.33	3.74	**3.56**
	AVERAGE	**3.37**	**3.44**	**3.46**	**3.83**	**3.46**

Rating: 5 = Strongly Agree, 4 = Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree

Like all the other internal determinants (academic self-concept, academic motivation and interest to learn), students' rating of their mental well-being borders between neutral (3.0) and agreeing (4.0) that they are mentally coping with their learning.

While the students rate high (4.02) on MW13 (interested in new things), their own self-rating on their thinking clearly (3.24) on (MW7), dealing with problems (3.27) on (MW6), and feeling confident (3.25) on (MW10) are relatively low.

The study by Mosleh et al. (2022) showed that the assessment in online learning resulted in a significant cause of psychological distress. They recommended precautionary measures and teaching strategies to ensure healthy mental well-being for the students. This is affirmed by the study conducted by Rao, M. E. and Rao (2021) on the mental health of high school students during the COVID-19 pandemic where they showed that three recurring causes mental stress: increased stress due to homework, social isolation or lack of social interaction, and lack of support for mental well-being. Schwartz et al. (2021) in their study showed that stress is related with self-reported behavioral concerns (conduct problems, negative effect, and cognitive/inattention) and stress arousal (sleep, problems, and hypervigilance).

Klapp et al. (2023) reported a positive correlation between mental well-being and academic performance, indicating the significance of mental well-being in achieving academic success. However, when examining specific aspects of mental well-being, students' self-ratings on thinking clearly (MW7), dealing with problems (MW6), and feeling confident (MW10) were relatively low. This finding confirms Ranadewa's study (2021), which demonstrated the impact of mental well-being on learners' satisfaction. Similarly, Grøtan et al. (2019) found a notable correlation between mental distress, academic self-efficacy, and study progress.

While there is a need to determine if such results with PSHS-CARC students may indicate academic stress or unhealthy mental health/well-being, this study will only try to determine the influence or relation of the student well-being with their learning satisfaction and academic performance.

Academic Performance (AP)

Academic performance in online learning refers to how well students perform academically in virtual educational settings. It encompasses achievements, grades, and overall learning outcomes. Factors such as self-concept, motivation, interest to learn and mental well-being may affect student academic performance. Similarly, teachers' attitudes and pedagogy or teaching styles as well as teaching tools like learning guides and KHub and adaptability to the online format influence academic success. In addition, evaluation methods include assessments, engagement, and completion of assignments. Institutions provide support services to help students succeed in online learning.

Aside from determining the relation of student learning satisfaction (SLS) with the above-mentioned indicators, one of the added purposes of this study is to also determine which of the above indicators influences the academic performance. The student academic performance is solely dependent on their final Chemistry course grades. The Chemistry grades of each student respondent were recorded with confidentiality.

Numerous studies have investigated various factors that influence students' academic performance and have consistently found that both external and internal determinants significantly impact academic achievement. These studies have examined the effects of teacher characteristics, assessment methods, learning design, gender differences, and the utilization of Learning Management Systems (LMS) on students' academic outcomes.

For instance, Mutinda and Mugambi (2020) discovered a positive and significant relationship between students' interest in learning and their academic performance. This finding was further supported by Arhin and Yanney's (2020) study, which emphasized the direct association between students' interest and academic success.

In a feedback analysis conducted by Rao and Rao (2021), three recurring themes emerged that affect academic performance: heightened stress related to homework, social isolation or the absence of social interaction, and a lack of support for mental well-being. These factors were found to have a detrimental impact on students' academic achievements.

Swerdloff (2016) emphasized the considerable influence of students' emotional state on their attitude and academic performance, underscoring the importance of addressing emotional well-being for optimal academic outcomes.

Regarding gender differences, Argallon et al. (2022) observed no significant disparity in the perceived effects of modular distance learning among students when categorized by gender. However, Wrigley-Asante et al. (2023) revealed that in high school, males tend to outperform females, while at the university level, females exhibit improved academic performance relative to males. Additionally, Ghazvini and Khajehpour's (2011) study suggests that boys and girls may adopt distinct cognitive-motivational approaches, with girls displaying a more adaptive learning style.

These studies highlight the multifaceted nature of factors that influence students' academic performance, including students' interest, stress levels, emotional well-being, and gender differences. Understanding and addressing these determinants can contribute to enhancing students' educational outcomes.

While each student's grade will be processed with the corresponding indicators, Table 4.10 below summarizes the average grades per grade level to give us an idea of how the students in general, per grade level, had performed academically. Students are given grades of 1.0, 1.25, 1.50, 1.75, 2.0, 2.25, 2.50, 2.75, and 3.0, with 1.0 as the highest grade.

Table 4.10
Average Chemistry Grade per grade level

	Average Chemistry Grade		
GRADE LEVEL	**MALE**	**FEMALE**	**ALL**
Grade 9	1.72	1.97	1.85
Grade 10	1.57	1.30	1.43
Grade 11	1.25	1.17	1.20
Grade 12	1.20	1.32	1.29

The Model Building for SLS and Academic Performance

The final step in this study is the model building for both SLS and AP. From the initial model where all determinants are considered, the survey data are processed using the SmartPLS where all significant connections (lines) in the SmartPLS graphical outputs are retained based on the calculated p-values at 0.05 level of significance. Doing so will lead to the reduced SmartPLS graphical model. The reduced model will then be rearranged towards a simplified and visually aesthetical graphical final model of both SLS and AP. This procedure of determining the final model is illustrated in Figure 3.12.

The grade 9 data will be used here to illustrate the development of the final SLS and AP models. The same procedure is performed for Grades 10 and 11. The development of the Grade 12 SLS and AP, due to its very small sample size, had a little deviation from those of the other grades. The deviation will be explained later in this same section.

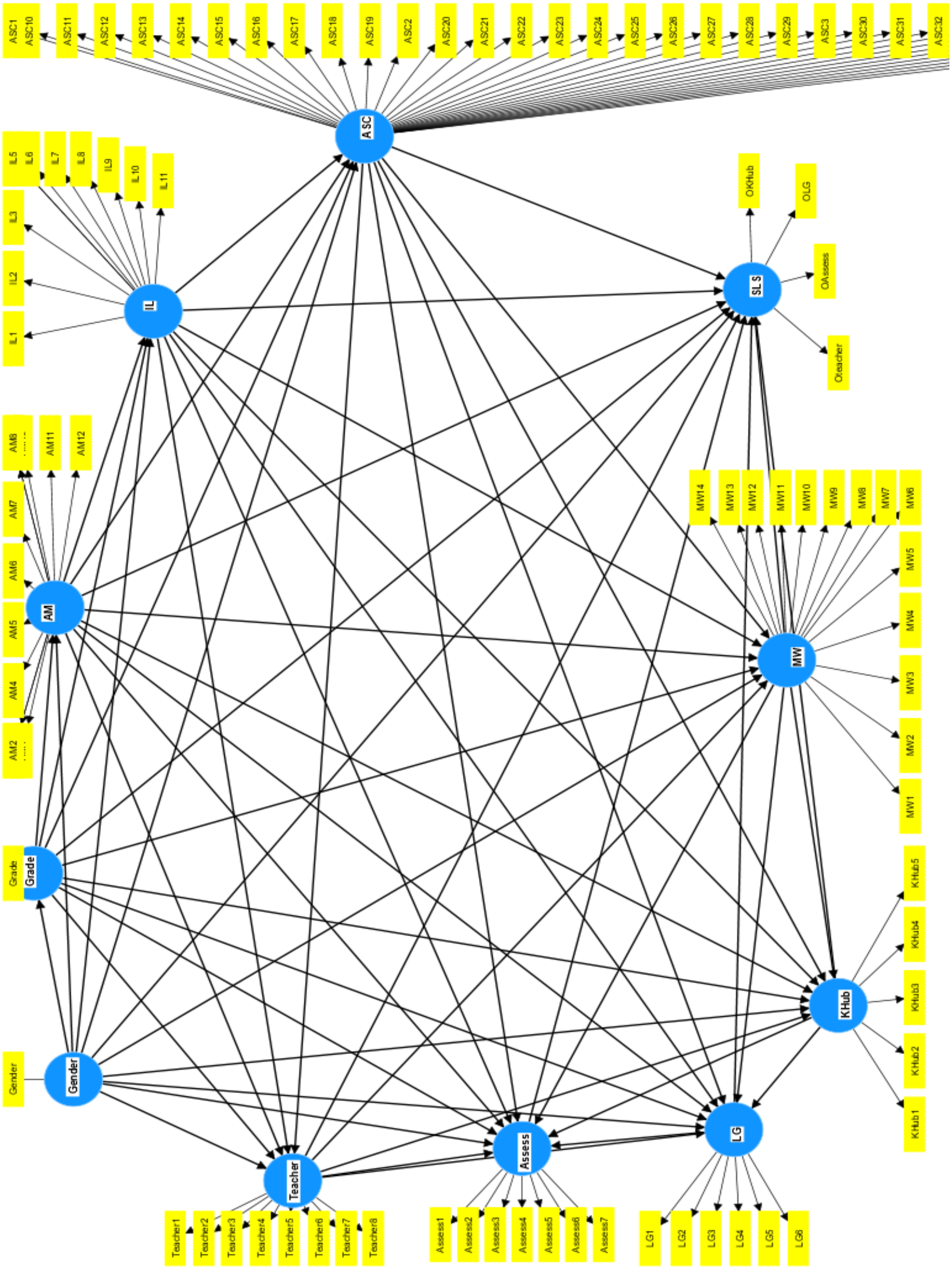


Figure 4.1. Raw and unprocessed model, all determinants are connected.

Figure 4.1 shows the initial unprocessed model (the first step in developing the model) which is created in the SmartPLS software which uses the PLS-SEM algorithm, a sequence of partial regressions. The PLS-SEM is a composite-based estimator of latent variable structural equation model. In this study, the latent variables are the determinants. The structural equation modelling feature is the reason why the SmartPLS was chosen as a tool for developing the SLS and AP models in this study. The SmartPLS is not only a fast data analyzing software, but also easy to use and convenient due to its visual and graphical output. The yellow rectangles represent the questionnaire item data while the blue circles are the determinants and dependent variables (SLS and AP). The questionnaire items (yellow rectangles) define the determinants (blue circles).

Additionally, the bootstrapping capability of SmartPLS is also used. The bootstrapping is used to test statistical significance of PLS-SEM results showing path coefficients, direct and indirect effects of the variables.

After running the PLS-SEM and bootstrapping calculations of the SmartPLS, statistical outputs can be extracted including a graphical output shown in Figure 4.2 which is a processed version of the raw data in Figure 3.7. The graphical output in Figure 3.7 is set to show p-values between each determinant. A p-value of less than 0.05 is deemed significant (0.05 level of significance).

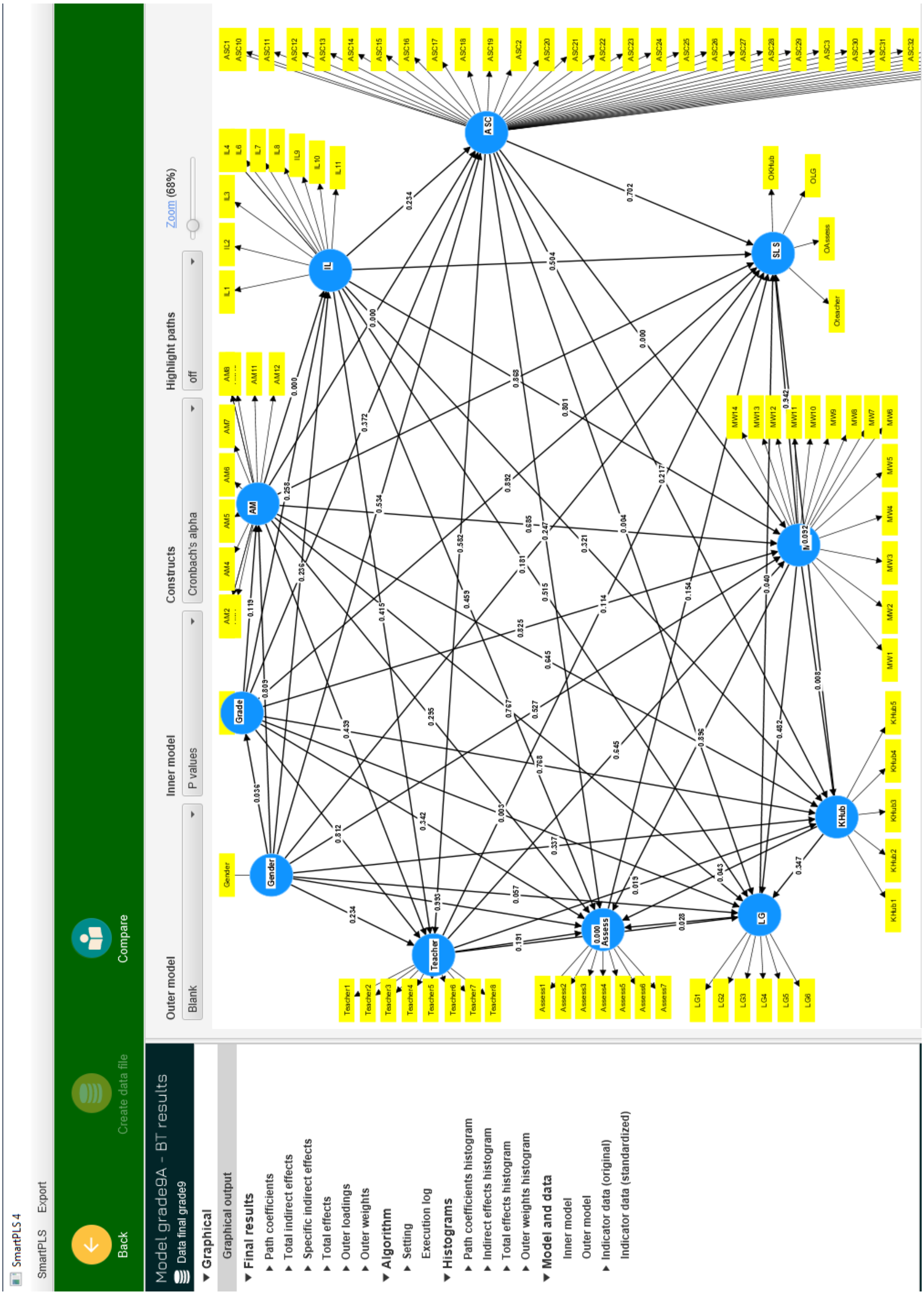


Figure 4.2. Graphical output of the SmartPLS showing p-values along connected variables/determinants.

Aside from the graphical output, data tables can also be extracted. The data table outputs list all p-values of all connected determinants entered in the software. The data tables are useful in double checking the p-values as well as easily identifying significant correlations. Figure 4.3 shows the Path Coefficient (p-values) table output. The green p-values correspond to the significant connections tested identified and specified in the first column of table while red values are non-significant.

The next step in the procedure of determining the final model is to remove all non-significant connections based on the p-values. This can be done in the graphical output by selecting non-significant lines and deleting such lines resulting in a reduced model shown in Figure 4.4.

Path coefficients - Mean, STDEV, T values, p values Zoom (100%) Copy to Excel Copy to R

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
AM -> ASC	0.934	0.919	0.148	6.302	0.000
AM -> Assess	-0.212	-0.180	0.202	1.048	0.295
AM -> IL	0.874	0.875	0.044	20.011	0.000
AM -> KHub	0.126	0.094	0.273	0.460	0.645
AM -> LG	-0.060	-0.054	0.201	0.296	0.767
AM -> MW	-0.118	-0.102	0.290	0.405	0.685
AM -> SLS	0.049	0.055	0.296	0.167	0.868
AM -> Teacher	0.235	0.252	0.303	0.773	0.439
ASC -> Assess	0.287	0.272	0.248	1.158	0.247
ASC -> KHub	-0.263	-0.235	0.213	1.235	0.217
ASC -> LG	0.510	0.501	0.176	2.901	0.004
ASC -> MW	0.794	0.807	0.177	4.481	0.000
ASC -> SLS	-0.088	-0.088	0.230	0.383	0.702
ASC -> Teacher	-0.112	-0.116	0.204	0.551	0.582
Assess -> SLS	-0.265	-0.244	0.186	1.425	0.154
Gender -> AM	0.076	0.098	0.313	0.242	0.809
Gender -> ASC	0.112	0.112	0.181	0.622	0.534
Gender -> Assess	-0.002	-0.011	0.198	0.009	0.993
Gender -> Grade	-0.534	-0.540	0.255	2.092	0.036
Gender -> IL	0.168	0.164	0.142	1.184	0.236
Gender -> KHub	-0.211	-0.214	0.219	0.961	0.337
Gender -> LG	0.337	0.340	0.177	1.903	0.057
Gender -> MW	-0.139	-0.147	0.220	0.633	0.527
Gender -> SLS	0.275	0.277	0.206	1.337	0.181
Gender -> Teacher	0.313	0.309	0.263	1.189	0.234
Grade -> AM	-0.250	-0.238	0.160	1.560	0.119
Grade -> ASC	-0.100	-0.102	0.112	0.892	0.372
Grade -> Assess	-0.097	-0.091	0.102	0.951	0.342
Grade -> IL	0.078	0.075	0.069	1.131	0.258
Grade -> KHub	-0.041	-0.035	0.139	0.295	0.768
Grade -> LG	0.276	0.275	0.093	2.962	0.003
Grade -> MW	0.019	0.015	0.084	0.221	0.825

Grade -> MW	0.019	0.015	0.084	0.221	0.825
Grade -> SLS	0.015	0.012	0.109	0.136	0.892
Grade -> Teacher	0.042	0.047	0.177	0.237	0.812
IL -> ASC	-0.182	-0.171	0.153	1.191	0.234
IL -> Assess	0.147	0.127	0.198	0.741	0.459
IL -> KHub	0.264	0.277	0.266	0.992	0.321
IL -> LG	0.107	0.099	0.165	0.651	0.515
IL -> MW	0.057	0.035	0.225	0.252	0.801
IL -> SLS	0.159	0.151	0.239	0.669	0.504
IL -> Teacher	0.217	0.225	0.266	0.816	0.415
KHub -> Assess	0.255	0.248	0.126	2.022	0.043
KHub -> LG	0.106	0.121	0.112	0.941	0.347
KHub -> SLS	0.323	0.349	0.192	1.687	0.092
LG -> Assess	0.381	0.401	0.173	2.204	0.028
LG -> SLS	0.419	0.368	0.204	2.058	0.040
MW -> Assess	-0.018	-0.018	0.137	0.131	0.896
MW -> KHub	0.388	0.391	0.146	2.653	0.008
MW -> LG	-0.083	-0.085	0.119	0.703	0.482
MW -> SLS	-0.011	-0.012	0.146	0.073	0.942
Teacher -> Assess	0.181	0.163	0.138	1.309	0.191
Teacher -> KHub	0.366	0.362	0.156	2.346	0.019
Teacher -> LG	0.511	0.504	0.087	5.875	0.000
Teacher -> MW	0.044	0.046	0.096	0.461	0.645
Teacher -> SLS	0.296	0.298	0.188	1.579	0.114

Figure 4.3. Screenshot of SmartPLS output for Grade 9 Path Coefficients values

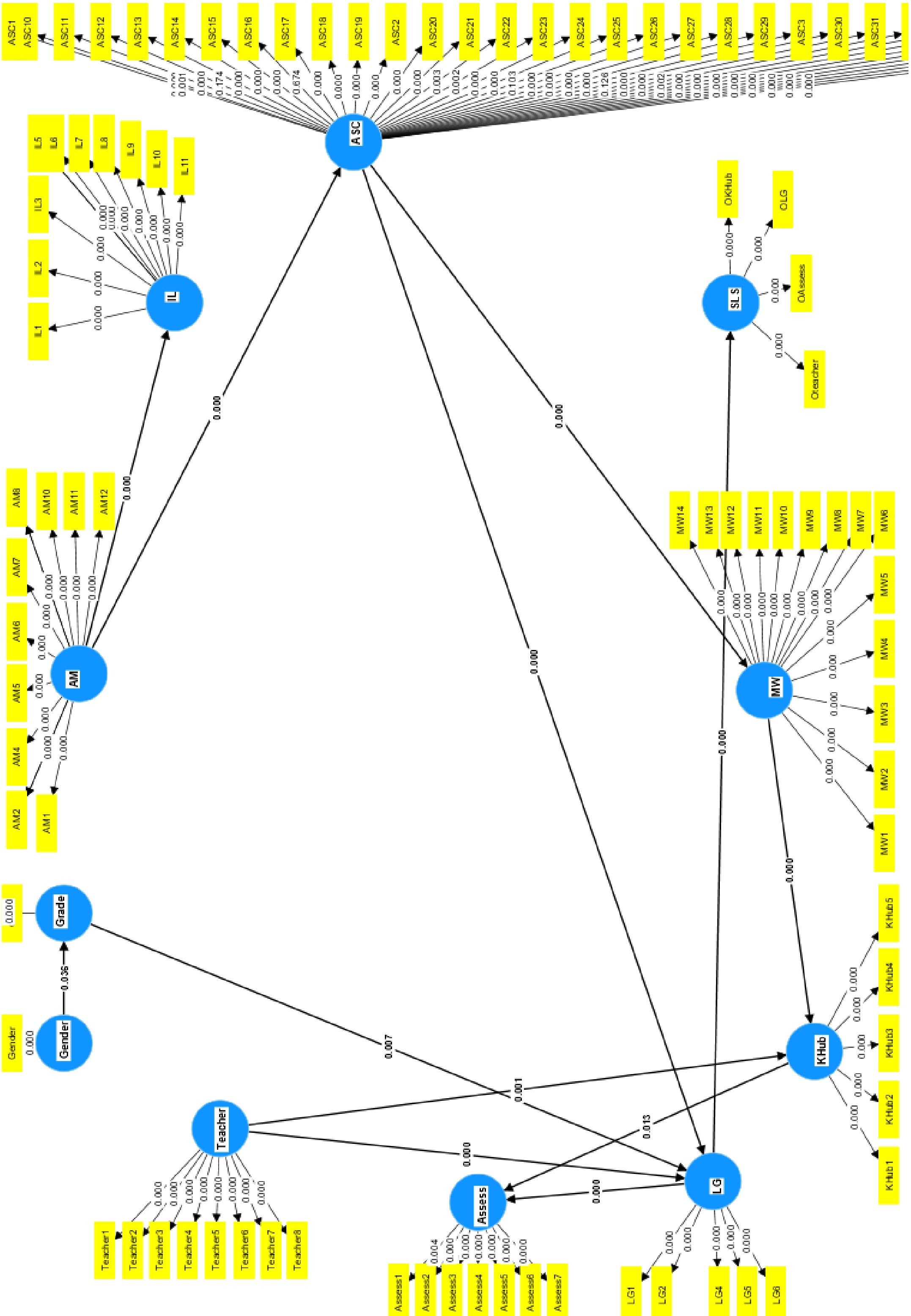


Figure 4.4. Reduced SmartPLS graphical output for Grade 9 (the lines/connections with p-values greater than 0.05 are removed)

Finally, the determinants are arranged accordingly to clearly show, in one simple model, the determinants which directly and indirectly influence SLS. This results in the SLS Model for the grade level shown in Figure 4.5.

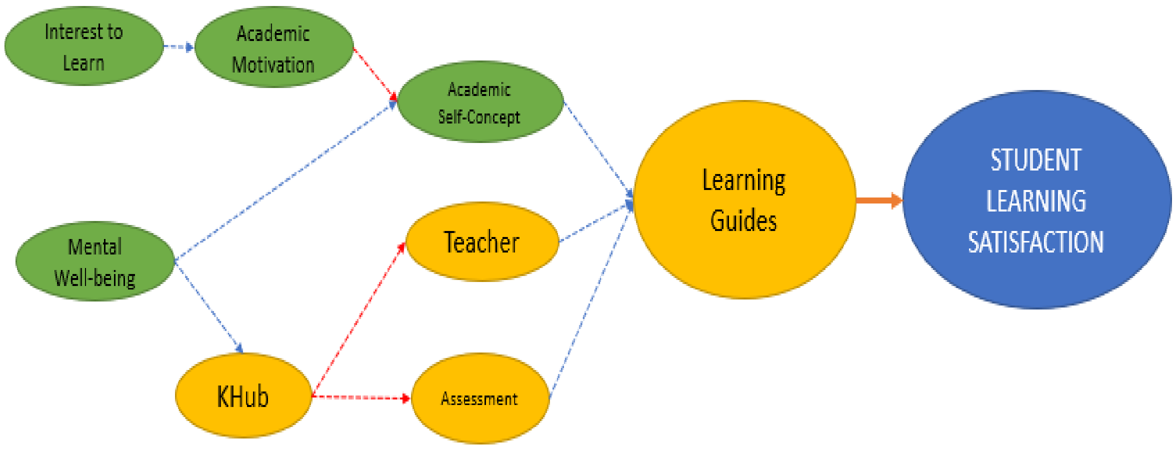


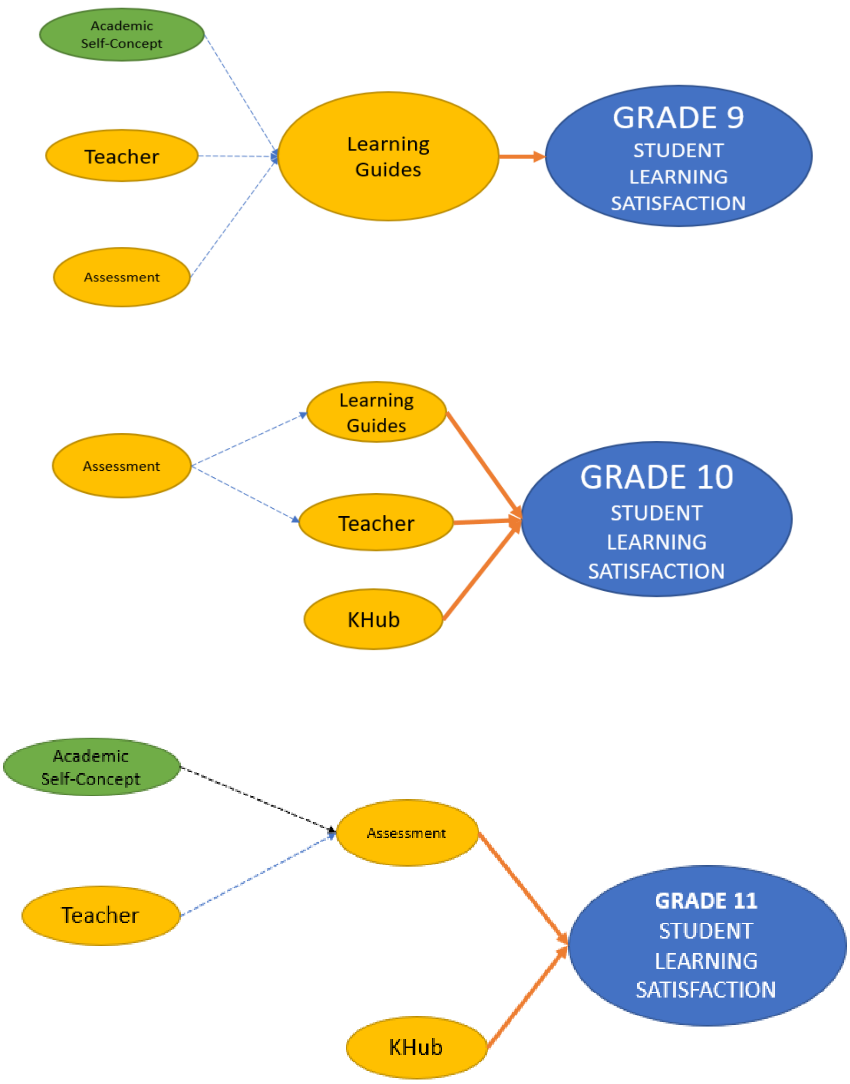
Figure 4.5. Grade 9 SLS Model

SLS and AP Models (per Grade Level)

The goal of this study is to determine the SLS model which best represents the relationships of all the external determinants (Teacher, Assessment, LG, KHub) and internal determinants (ASC, AM, IL, MW) in one graphical, easy to interpret representation or graph. The procedure above is repeated for all grade-level data. Starting with the full connections for all determinants without any initial assumption about which ones are significantly related to each other, the SmartPLS then calculates the p values for each line. The next step is to come up with the Reduced SmartPLS graphical output where all non-significant lines are removed. Finally, the determinants are re-arranged so that direct effect determinants and indirect determinants of the final SLS model are easily recognizable. The same procedure is also done for the final AP models. In this section, the final model for SLS and AP for each grade level is shown and discussed. However, the determinants with direct and first-order indirect connection per grade level are the ones highlighted and discussed.

The Final SLS Models

Figure 4.6 shows the Final SLS Model for each grade level to easily see direct and first-degree indirect determinants to the SLS for each Grade level as a result of the above-mentioned procedure performed with the SmartPLS.



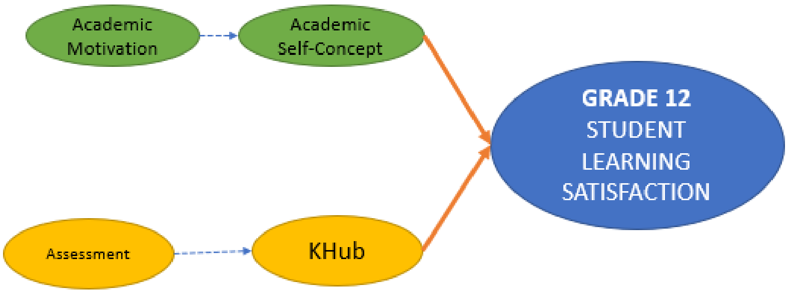


Figure 4.6. SLS Model for each Grade Level showing direct and indirect (first degree only) determinants.

Each of the grade level SLS models shown in Figure 40 are the result of the SmartPLS procedure mentioned in the Model building process except for the Grade 12 data. Due to the small number of respondents for Grade 12, the SmartPLS cannot process all determinants because the number of determinants or latent variables are comparable in number to the sample size. The SmartPLS software expects that the sample is much larger than the number of parameters or variables.

To remedy this, the internal and external variables are separately calculated. On one calculation, only the external determinants are connected to SLS and AP. Then on another calculation, only the internal determinants are connected to the SLS and AP. The justification for this is the observations with grades 9 and 10 where the internal determinants are not correlated with the external determinants. The results of these two calculations are combined into one model for the Grade 12 SLS and AP models.

Interpretation of resulting SLS model per grade level are as follows:

1. **LG** showed ***direct*** significance to the SLS in Chemistry for Grade 9 and 10. This can be explained by the high reliance of the younger students on the LG during the academic year 2021-22. With the student learning to be an independent learner towards lesser and lesser contact with the teacher, the LG has become the main source of "personal" contact (indirect) between the student and teacher where instructions on what topics to study and which activities and problems to solve are stated and explained. LGs have become the manual for students in their learning process for the younger learners. However, the results also showed that older students appear to be not satisfied with the LG and may have resorted to other sources and references for learning the Chemistry lessons. The study of Rabajalee and Santaly (2020) reported that the implementation of modules in online learning had a significant and positive effect on learning satisfaction and engagement in learning.

For example, in Appendix R summarizing the qualitative responses of the students, PSHS-CARC Chemistry students in all grade levels agree that clarity of the directions in the LG is most important. Next in importance is the completeness of the LG followed by creativity. These factors or features must be taken advantage towards designing the LG aimed at the learning satisfaction of the students. On the contrary, based on the student responses, the LG becomes a negative determinant to learning satisfaction if they are too lengthy in content and too long in time allotment for the students to complete.

2. **Assessment** showed ***indirect*** significance to the SLS of the students in Chemistry for all grade levels. Interestingly, Assessment is significantly related to LG and KHub. LGs give directions to the students on which assessment activities to do. Hence, it is not a surprise that LG and assessment are closely and significantly related to each

other. The KHub is also used for online assessment activities. Students find learning satisfaction with how the teacher facilitated their online learning (Cole et al., 2014). Assessments are found to influence learning satisfaction if timely feedbacks are given. The study of Bahati et al. (2019) found out that students expressed satisfaction with the quality of their engagement and the feedback provided in all formative e-assessment activities. Similarly, Dziuban et al. (2015) reported that satisfied students are characterized by an ability to assess and monitor their progress and indicate that a timely response by the instructor plays an important role in their satisfaction. These studies showed that SLS are affected by timely results and student engagement and not on the type of assessment.

Based on the students' qualitative responses in Appendix R, the students find the time allotted to complete the assessment, the type of assessment and the number of assessments required in the Chemistry course is reasonable. The students appreciated the flexibility of setting deadlines for the assessments. However, the Grade 9 students complain of the level of difficulty of assessments, the Grade 10 students complain of unclear instructions in assessments, the Grade 11 students complain of inconsistent intervals of giving assessments (there are less assessments at the start of the school year but assessments flood in at the end of the school year) and the Grade 12 complain of the assessment outputs that replace quizzes and exams like requiring the students to submit PowerPoint and video presentations, infographics and other creative outputs.

3. Another remote learning support, the **KHub**, shows ***direct*** significance to the SLS for all grade levels except grade 9.

Learning Management System (LMS), like the KHub, is a must for online learning. However, for the LMS (KHub) to be a determinant of learning satisfaction, it must be developed to ensure that students who would use it would feel comfortable in its ease of use, usefulness and navigation (Ohliati and Abbas, 2019; Alkhateeb and Abdalla, 2021; Naveh et al., 2012; Yulyanty and Togar, 2021; G and Wijewardana, 2016; Nguyen, 2021).

Drawing from the qualitative responses of the students in Appendix R, aside from its perceived ease of use and easy to navigate, the KHub was also noted to be easy to access using different digital gadgets. However, the dissatisfaction stems not from the LMS itself but in the speed and stability of internet available for the students. The problems of slow or no internet connection continues to be a problem in learning through the LMS. The students' complaint also includes erratic notification due to internet problem. In spite of this, students who use the KHub as an integral tool for learning for PSHS in online learning find a level of learning satisfaction in its use.

Results 2 and 3 indicate that the remote learning tools (LG and KHub) are significant and important to the learning satisfaction of the PSHS-CARC Chemistry students.

4. The **Teacher** has different effects on each grade level. Grade 10 students see their Teacher Satisfaction as directly related to their learning satisfaction while Grade 9 and 11 students show their learning satisfaction to be indirectly related to their teacher satisfaction. The Grade 12 students do not see teacher satisfaction influencing their learning satisfaction. This may be attributed to the fact that higher grade levels PSHS students are taught to be more independent learners. Students find learning

satisfaction with how the teacher facilitated their online learning (Cole et al., 2014). Assessments are found to influence learning satisfaction if timely feedbacks are given (Dziuban et al. 2015; Bahati et al. 2019).

PSHS hires and assigns teachers who are experts and masters of the courses they teach. This is a standard for PSHS in upholding the high quality of education PSHS is expected as a premier science high school institution. In some cases, the lessons are at the same level as those taught in university-level courses, even for Chemistry. Based on the students' responses in Appendix R, while the students do not complain about the requirements demanded of the courses, they appeal for consideration of the expectation of the teacher that they should easily understand the lesson taught and that they should strictly follow deadlines of submissions of the course regardless of circumstances. The students seem to appeal for a little space or allowance for them to absorb the lesson and enough reasonable time to complete requirements. The late return of their outputs and feedback on their completed activities is a source of teacher dissatisfaction for the grade 9 Chemistry learners.

5. Among the internal determinants, **ASC** shows a ***direct*** effect on SLS for Grade 12 students and ***indirect*** effect on SLS for Grade 9 and 11 students. The factors IL and MW do not show any influence on the learning satisfaction of students. AM only indirectly affected the learning satisfaction of Grade 12 students. However, the relatively low ratings on these internal factors (3.38 for ASC, 3.40 for AM, 3.52 for IL, and 3.46 for MW) signal that possible intervention may be needed for the PSHS students on these. It is interesting to note that the ASC is significantly connected to the LG. One possible explanation might be that the LGs are meant for self-study. The

study by Hassan et al. (2021) showed that positive academic self-perceptions were found to strongly influence satisfaction in the course. Hence, a high self-perception of the student's academic self-concept/abilities that they can learn on their own with minimum supervision through the LG is important.

While the SLS model is dominated by external determinants (LG, KHub, Teacher, and Assessment), the Academic performance Model is dominated by internal determinants (ASC. AM. IL and MW). This means that the student learning satisfaction is influenced by external factors and the academic performance of the Chemistry students is affected by internal factors.

The Final Academic Performance Model

Figure 4.7 shows the Final Academic Performance Model to easily see direct and first-degree indirect determinants to the academic performance/grade of the Chemistry students.

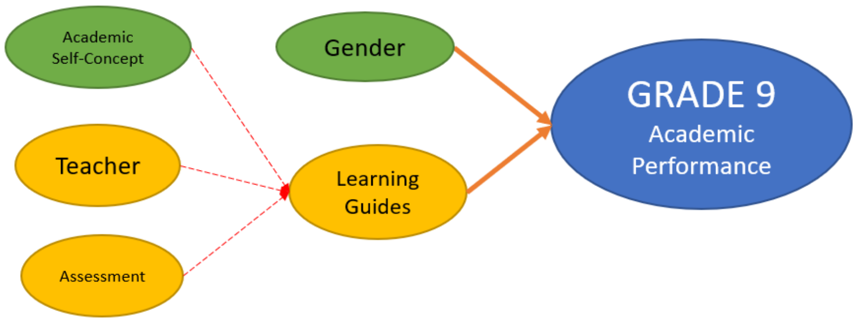


Figure 4.7. Academic Performance Model for each Grade Level showing direct and indirect (first degree only) determinants.

The resulting Academic performance model per grade level is summarized as follows:

1. **Gender** appears to be a factor in the academic performance of Grade 9 and Grade 10 students but not for Grade 11 and Grade 12. Based on the results, Grade 10 male learners have higher Chemistry grades than their female counterparts. This

corroborates the study of Wrigley-Asante et al. (2023) on STEM high school students which revealed that the males perform better in their academics than females.

On the other hand, Female PSHS -CARC Chemistry Grade 9 students have higher grades in Chemistry than the male Grade 9 students. Parajuli and Thapa (2017) presented a study where female grade nine students performed better that their male counterparts in a grade eight standard exam.

However, the contrasting results for Grades 9 and 10 mean that it is not conclusive to infer which gender has a better academic performance in Chemistry. The study by Ghazvini and Khajehpour (2011), for example, showed no significant difference in the academic performance across gender.

2. The external factors (Teacher, Assessment, and LG) have varying effects on academic performance at different grade levels.

Teacher satisfaction directly influences the Grade 12 academic performances and indirectly influences the Grade 10 and 11 students. One significant study conducted by West (2016) revealed that teachers have significant effects on various aspects of students' attitudes and behaviors, in addition to their academic performance. This suggests that teachers play a crucial role in shaping not only academic achievements but also the overall development of students.

In another study by Gilbert (2018), the focus was on examining the relationship between student performance, teacher communication orientations, and student communication preferences, particularly among students in Grades 6 to 9. The findings of this study suggest that teacher communication orientations and student communication preferences can impact student performance. Effective communication between teachers and students is therefore essential for fostering better academic outcomes.

Knowledge Hub **(**KHub) does not show any effect on the student's academic performance or grades. KHub is not a significant determinant of the student's academic performance/grade for all grade levels.

3. The internal factors (ASC, AM, IL, and MW) also showed varying effects on the academic performance of the Chemistry learners.

ASC showed significant effect on the academic performance/grade for all grade levels (direct for all grade levels except Grade 9 which is indirect). This means that a high Academic Self Concept (ASC) is an important factor for the students to have higher academic performance or grades in Chemistry. This validates the meta-analysis report of Marsh and Martin (2011) which showed that higher ASC results in higher academic performance. Similarly, the findings of Cruz and Lumahan (2022) which suggested that learners' beliefs about their academic abilities play a crucial role in their educational achievements also holds true for the PSHS-CARC Chemistry students.

However, the general average rating for ASC of the PSHS-CARC students, which is 3.38, is relatively low. There may be a need in helping the students improve their ASC can be considered. MW, IL, and AM have an indirect effect on the academic performance of Grade 10 students. However, AM, IL, and MW do not show a significant effect on Grade 9 academic performance. Akomolafe et al. (2013) identified academic self-efficacy, academic motivation, and academic self-concept as predictors of students' academic performance. Specifically, for Grade 9 students, academic self-concept played a significant role, while academic motivation had a stronger influence on Grade 10 students' academic performance. Ilo and Onyeyesi (2021) and Amrai et al. (2011) confirmed the importance of academic motivation in enhancing students' learning success and academic performance. Additionally, Acosta-Gonzaga's (2023) findings suggested that self-esteem affects emotional and behavioral disengagement, while motivation plays a more substantial role in academic engagement. Notably, metacognitive engagement emerged as a significant predictor of academic performance.

The studies conducted by Mutinda and Mugambi (2020), Mappadang et al. (2022), and Ezike (2018) revealed a significantly positive relationship between students' interest in learning and their academic performance. Arhin and Yanney (2020) investigated the correlation between academic performance and interest in Mathematics, finding that low performance in Mathematics could be attributed to a lack of interest in the subject.

For the Grade 11 and 12 learners, MW shows a significant (indirect) effect on academic performance. Swerdloff (2016) underscores the profound impact of students' emotional state on their attitudes and academic performance. However, he also highlights the unfortunate tendency of conventional educational environments to overlook and disregard the emotional well-being of students. Moreover, Schwartz et al. (2021) have drawn attention to the alarmingly high levels of stress experienced by students, particularly among female and older adolescents (15-18 years old), in comparison to younger males. Their findings substantiate the earlier study's conclusion that the effect of MW on academic performance is indirectly linked. These studies collectively reveal that mental well-being plays a significant and often underestimated role in determining the academic outcomes of Grade 11 and 12 students. The emotional state of students directly influences their attitudes towards learning and ultimately impacts their academic performance. Furthermore, the prevalence of heightened stress levels further supports the notion that MW indirectly affects academic success.

While the SLS model is dominated by external determinants (LG, KHub, Teacher, and Assessment), the Academic performance Model is dominated by internal determinants (ASC. AM. IL and MW). This means that the student learning satisfaction is influenced by external factors and the academic performance of the Chemistry students is affected by internal factors.

Chapter V

SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter presents the concise overview of the key findings, summary, the derived conclusions, and recommendations of the study.

Summary

The study was conducted to determine the SLS model and Academic Performance model that best represents the PSHS-CARC Chemistry learners by identifying the determinants that affect student satisfaction, both directly and indirectly, in the implementation of online learning. To develop the SLS model, the participants were requested to answer the survey questionnaires on student satisfaction, academic self-concept, academic motivation scale, interest to learn questionnaires, and mental well-being scale. The participants are grade 9, 10, 11, and 12 students who are enrolled in Chemistry 1, Chemistry 2, Chemistry 3, and Chemistry 4 respectively. The survey questionnaire on student satisfaction is a researcher-made questionnaire that includes all the probable determinants that may affect student satisfaction. Survey questionnaires on academic self-concept, academic motivation scale, interest to learn questionnaires, and mental well-being scale was developed based on existing literature and validated by certified guidance counselors.

Specifically, the instrument used aimed to produce a SLS model that can be used to determine which external and internal determinants affect student satisfaction in the implementation of online learning.

The first step towards this model-building study is to identify which of the determinants have a direct and indirect influence on the student learning satisfaction of the PSHS-CARC Chemistry students. Another model showing which determinants influence the Chemistry academic performance of the same students will also be presented.

As a final procedure, aside from the direct effect determinants, only first-degree indirect effect determinants were considered in the final SLS Model and Academic Performance Model for each Chemistry Grade Level. First-degree indirect determinants are defined as those which are connected to SLS with one direct determinant. In other words, first-degree indirect determinants are connected by two-line paths to the SLS or to Academic Performance.

Table 5.1 summarizes the determinants which have a direct and first-degree indirect effect on the student learning satisfaction (SLS) and their academic performance represented by their final grades in their Chemistry courses. The numbers in the parenthesis indicate the grade level to which the determinant was found applicable. For example, LG (9,10) in the first row, the second column means that LG (9,10,11) is a direct determinant for SLS for grades 9,10 and 11. Assessment (9,10,12) in row 2 column 1 means that assessment is an indirect determinant for grade levels 9,10, and 12.

Table 5.1
Summary of Direct and Indirect Determinants of SLS and Academic Performance of PSHS-CARC Chemistry students

	SLS	**ACADEMIC PERFORMANCE/GRADE**
DIRECT	LG (9, 10) KHub (10, 11,12) Teacher (10) Assessment (11) ASC (12)	LG (9,10,11) Gender (9,10) ASC (10,11,12) Teacher (12)
INDIRECT **(First degree only)**	Assessment (9, 10, 12) ASC (9,11) Teacher (9, 11) AM (12)	ASC (9) Teacher (9,11,12) Assessment (9,10) AM (10) IL (10,11) MW (10, 11, 12)

LG showed direct significance to the SLS in Chemistry for younger students. The results also showed that older students appear to be not satisfied with the LG and may have resorted to other sources and references for learning the Chemistry lessons. Assessment showed indirect significance to the SLS of the students in Chemistry. Assessment is significantly related to LG and KHub because both are used for online assessment activities. The KHub, shows direct significance to the SLS for all grade levels except grade 9. These results indicate that the remote learning tools (LG and KHub) are significant and important to the learning satisfaction of the PSHS-CARC Chemistry students.

The Teacher has different effects on each grade level. Grades 9, 10 and 11 students see their Teacher Satisfaction as related (either directly or indirectly) to their learning satisfaction while the Grade 12 students do not see their teacher satisfaction influencing their learning satisfaction.

Among the internal determinants, ASC shows either direct or indirect effect on SLS for all Grade levels. All other internal factors (IL and MW) do not show any influence on the learning satisfaction of students. AM only indirectly affected the learning satisfaction of Grade 12 students. The relatively low ratings of these internal factors signal that possible intervention may be needed for the PSHS students.

Overall SLS Model for the PSHS-CARC Chemistry Students

The SLS model that would best represent the PSHS-CARC Chemistry students would be the model that incorporates all respondents from all grade levels.

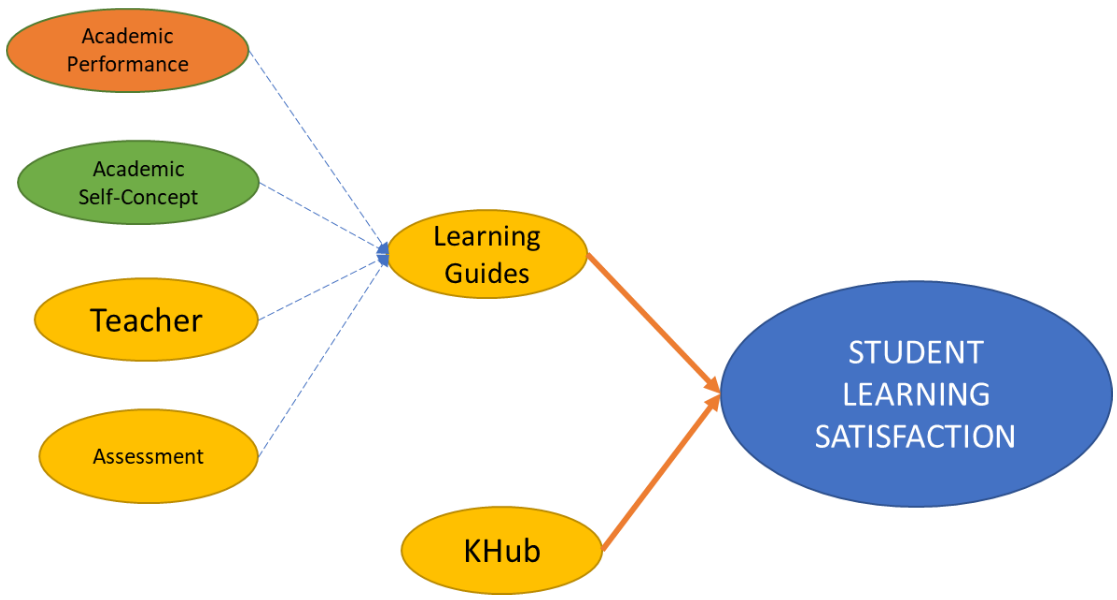


Figure 5.1. Overall SLS Model for all Chemistry students (all Grade Levels) showing direct and indirect determinants.

The above Overall SLS model (Figure 5.1) is a representative SLS model for all grade levels combined (SLS model for all Chemistry students). The Overall SLS model is developed to be consistent with the survey results and one glance at the SLS model shows the following important results:

1. LG as a direct determinant of SLS: This SLS model is consistent to all grade levels in terms of the LG as a directly influencing determinant of the student learning satisfaction.
2. KHub as a direct determinant of SLS: The KHub as a direct determinant is consistent for Grades 10, 11, and 12.
3. Internal factors (AM, IL, MW) are neither direct nor indirect determinants: This model is also consistent with all grade levels showing that internal factors do not directly influence their learning satisfaction in the online mode of learning for Chemistry.
4. Assessment as an indirect determinant of SLS: Assessment as indirectly influencing the student learning satisfaction of the Chemistry learners is consistent for all grade levels.
5. Teacher as an indirect determinant of SLS: Grade 9 students indicated indirect relation of teacher to the SLS. Grade 10 students, on the other hand, indicated direct relationships. But the Grade 11 and 12 students (combined) neither indicated the teacher as having direct nor indirect relation to SLS. So, for the overall SLS model, an indirect relation is most likely.

6. ASC as an indirect determinant of SLS: In all grade levels, the ASC is found to be a first-degree (Grades 11 and 12) or second-degree (Grades 9 and 10) indirect determinant.
7. Academic performance as an indirect determinant of SLS: For the young learners (Grade 9 and Grade 10 Chemistry learners), the result of the study showed that the learning satisfaction of the students does not directly influence their Academic Performance (represented by their Chemistry grades). However, for these young Chemistry learners, this study showed that the Academic Performance is indirectly related to the learning satisfaction through the LG determinant.

   For the older Grade 11 and 12 Chemistry learners (junior and senior high school students, respectively), there was no significant connection between the learning satisfaction and their academic performance. This may mean that the more mature PSHS-CARC Chemistry learners are able to perform well academically (high grades) regardless of the quality of their learning satisfaction experience.

Overall AP Model for the PSHS-CARC Chemistry Students

Similarly, the AP model that would best represent the PSHS-CARC Chemistry students would be the Overall Academic Performance (AP) model shown in Figure 5.2. This overall AP model is a representative AP model for all grade levels combined. The Overall AP model is developed to be consistent with the survey results and a glance at the AP model shows the following salient points:

1. LG is a direct determinant of Academic performance: This Academic performance model is consistent to all grade levels in terms of the LG as a directly influencing determinant of the academic performance of the Chemistry students.
2. Assessment as an indirect determinant of academic performance: Assessment as indirectly influencing the academic performance of the Chemistry learners is consistent for grades 9 and 10.
3. The KHub does not directly or indirectly affect academic performance, and this conclusion is consistent across all grade levels.
4. Internal Factors (MW, IL, and AM) as indirect determinants of academic performance: Mental Well-Being is an indirect determinant of academic performance for all grade levels except Grade 9.
5. ASC as a direct determinant of academic performance: ASC is a determinant of academic performance in all grade level.

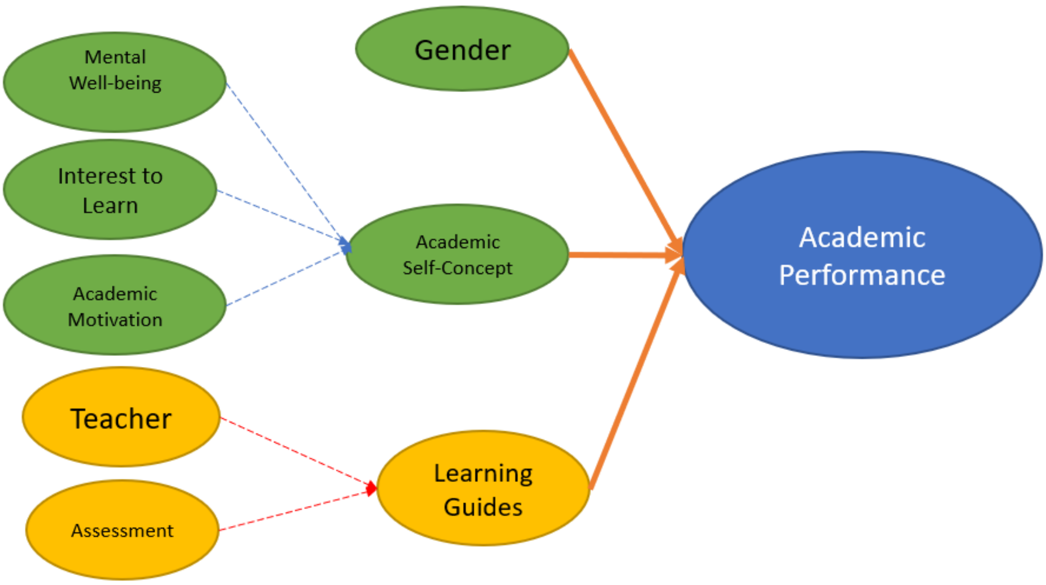


Figure 5.2. The Overall Academic Performance Model for all Chemistry students (all Grade Levels) showing direct and indirect determinants.

Conclusion

On the Overall Satisfaction of Chemistry Learners

Student learning satisfaction must be taken into consideration whether the learning modality is the traditional classroom setting or online mode. Being forced into online learning due to the pandemic, it is more imperative therefore to assess the effectiveness of the methods and strategies used for online learning related to the learning satisfaction of students (Chen et al., 2020). Hence, this study was conducted for this very purpose.

The PSHS CARC Chemistry learners are found to be satisfied with ALL the external determinants (Teacher = 4.54, Assessment = 4.26, LG=4.18 and KHub=4.18). The two remote learning tools had the lowest ratings. It is also interesting to note that both LG and KHub have a significant influence on the learning satisfaction of the PSHS CARC Chemistry students.

However, among the four external determinants, both LG and KHub garnered the lowest ratings although the satisfaction ratings of 4.18 are just a little above satisfactory. This is not a surprising result for developing countries like the Philippines. Online learning satisfaction in developed countries is better because they possess the e-learning technologies and knowledge to apply such technologies in education (Abassi, et.al., 2020)

Developing countries like the Philippines, on the other hand, find difficulties like technical problems (slow internet) and financial problems (not affording needed gadgets for online learning) and lack of e-learning technologies for the classroom online learning. Such limitations are acceptable, but educators should be aware and wanting for the need to improve the classroom online learning (Abu Hantash et al., 2020; Adnan & Anwar, 2020). Hence, further study to evaluate and improve these remote learning platforms (LG and KHub) for PSHS may need to be done for better learning satisfaction.

On the Internal Factors of Chemistry Learners

The PSHS CARC Chemistry learners have relatively low ratings on their internal determinants (ASC =3.38, AM=3.40, IL=3.52, and MW=3.46). Such rating borders between neutral and agreeing that they have a satisfactory academic self-concept of their learning ability, motivation, and interest to learn, and the right mental well-being to learn. While they have a relatively low assessment of themselves as learners, they appear to perform well as evidenced by their high Chemistry grades. Being not fully satisfied with learning but performing well academically is a puzzling result. While it may indicate that PSHS CARC Chemistry students can cope and perform academically well despite relatively low perceptions of their internal (mental and psychological) aspects, PSHS may further need to assess and consider improving these internal determinants not only for their learning satisfaction or academic performance but in their better character and values as learners.

On the SLS Model

The result of the study showed indirect relation between SLS and academic performance. SLS and academic performance are indirectly related through one determinant, the LG. This means that specifically for the PSHS education system, student satisfaction, and academic performance are entirely separate matters.

In general, internal determinants have no direct influence on the SLS. This means that the students get their learning satisfaction from the external determinants. Student learning satisfaction is derived directly from LG and KHub and indirectly through Teacher and Assessment. In other words, external determinants (LG, KHub, Teacher, Assessment) dominate the model. Only one internal determinant, academic self-concept, is indirectly related to SLS.

External and internal determinants are independent of each other. Internal determinants do not influence the external determinants.

While we expect that students will get higher grades if they have better learning satisfaction, the result of the PSHS Chemistry learners' perceptions showed a different picture. Their goal of attaining high grades is not tied directly to their learning satisfaction.

On the relationship of Student Learning Satisfaction and their Academic Performance

For the young learners (Grade 9 and Grade 10 Chemistry learners), the result of the study showed that the learning satisfaction of the students does not directly influence the Academic Performance (represented by their Chemistry grades). In addition, for these young Chemistry learners, this study showed that the Academic Performance is indirectly related to the learning satisfaction through the LG determinant.

For the older Grade 11 and 12 Chemistry learners (junior and senior high school students, respectively), there was no significant connection between the learning satisfaction and their academic performance.

On the Academic Performance Model

Academic Performance is important for PSHS because it is an indicator of the student's academic achievement rather than their learning satisfaction.

A stark contrast to the SLS model, which is dominated by external determinants, the academic performance model is clearly dominated by internal determinants.

The students appear to achieve high grades on their own. The external determinants LG and Assessment are in the academic performance model because they are the tools to achieve high grades.

The academic performance model highlights the lack of emphasis on student learning satisfaction (SLS). It confirms that the focus of the students is primarily on achieving high grades rather than valuing their learning experience. While learning satisfaction and academic performance are distinct objectives for PSHS Chemistry students, it appears that the students prioritize the latter over the former.

At PSHS, the prevailing perception is that students are primarily driven to obtain high grades. Their primary concern seems to be achieving academic success, with less consideration given to whether they find satisfaction in the learning process. Teachers (in their instruction and assessment), educators/curriculum coordinators (in designing the LG and KHUB), and administrators (in giving premium to honor students), all contribute to this mindset by placing a higher premium on students' grades rather than on their learning satisfaction.

It is crucial for PSHS to reflect on the implications of this model's results. The question that arises is whether this emphasis on academic performance the most effective approach is to develop our young Filipino scholars. Alternatively, PSHS should consider whether there is a need to reform its philosophy of learning to strike a better balance between academic achievement and fostering a genuine love for learning.

The Student Learning Satisfaction (SLS) Model and Academic Performance (AP) Model as Predictive Models for Online Learning

A prediction model for online learning can be used to predict student performance or behavior in an online learning environment. By analyzing these variables or determinants, the model can identify patterns and trends that can be used to predict future student behavior or performance.

In this study, the developed SLS and AP models can be used as predictive models of student behavior and their Chemistry grades, respectively. The SLS Model can be used to predict the likelihood that the student will enjoy and find satisfaction in learning the lessons in a difficult subject like Chemistry. The AP Model can be used to predict the likelihood of a student getting a high grade in their Chemistry subject. Furthermore, the SLS and AP Models as prediction models for online learning can help educators and administrators to provide targeted support to students, leading to improved outcomes and success in online learning environments.

Specifically for this study, LG and KHub appear to be the predictors of student learning satisfaction which is not surprising since they are the main learning tools and resources available to the students due to the COVID-19 pandemic forcing the use of remote learning mode. Based on this SLS model, the student learning satisfaction on these two online platforms used in their online learning directly predicts their overall satisfaction in online learning in Chemistry. Hence, if learning satisfaction in remote online learning is to be ensured, at least for the PSHS CARC Chemistry students, the LG and KHub must be of high quality and standard. PSHS CARC must address the proper student pacing and justifiable time allotment for accomplishing activities of their independent learning using the LG. As for the KHub, it is necessary to address the issue of providing the students with stable and fast internet if and when they are required to use the KHub for their learning time. The information, service quality, and ease of use are important factors for student learning satisfaction in the use of LMS according to the study of Ohliati and Abbas (2019) and these are found in the KHub used by the PSHS CARC Chemistry students. However, these good features of the KHub will not be enjoyed and experienced by the students when their internet is slow and unstable.

The AP model predicts that students with high ASC would have higher grades. Also, from the AP model in Figure 37, ASC is influenced by the student's perception of their mental well-being, interest to learn the subject, and academic motivation. In other words, high MW, IL, and AM lead to high ASC which in turn leads to a higher grade in Chemistry. The AP model also indicated that the LG predicts the Chemistry grade, which is expected because all assessment and grading requirements are incorporated in the LG.

In summary, one of the important results of this study was that both online learning platforms used by PSHS CARC, the LG, and KHub, were found to be effective tools for student learning satisfaction. PSHS CARC may need to improve more on these two determinants towards more positive learning satisfaction experiences for their Chemistry learners. This result (especially for LG) is further reinforced by the fact that learning satisfaction and academic performance (Chemistry grade) are related (indirectly) to each other through the LG. This means that the LG used by PSHS CARC was an effective tool for their online mode of learning. PSHS CARC must take advantage of the use of the LG for the student to enjoy independent online learning (positive learning satisfaction) because learning satisfaction translates to better academic performance for their Chemistry learners.

The other important result is that external determinants (LG, KHub, Teacher, Assessment) dominated the SLS models while internal determinants (ASC, AM, IL, MW) dominated the Academic Performance model for the PSHS CARC Chemistry students. It appears that the internal determinants and external determinants are independent of each other and affect only one of the dependent variables (SLS or academic performance). In other words, the external determinants influence the student's learning satisfaction while the internal determinants influence the academic performance of the Chemistry students.

These study findings are recommended to be used as a basis to make adjustments to the learning strategies for their future Chemistry learners and/or implement educational policies or intervention programs for the improvement of learning satisfaction and academic performance of PSHS CARC Chemistry students.

Implication of the Study

The findings from this study in terms of student learning satisfaction and academic performance in Chemistry emphasized several implications in the educational system specifically in PSHS CARC.

Effectiveness of Online Learning Platforms

The study concludes that both LG and KHub are effective tools for enhancing student learning satisfaction. This suggests that the online platforms provided a positive and engaging learning experience for Chemistry students at PSHS CARC.

Areas for Improvement

Despite the overall effectiveness of the online platforms, there is room for improvement in terms of learning satisfaction. PSHS CARC should focus on enhancing certain aspects of these platforms to further enhance the positive learning experiences for students. Identifying and addressing specific areas of concern can lead to even higher levels of satisfaction among Chemistry learners.

Link between Learning Satisfaction and Academic Performance

The study highlights a link between learning satisfaction and academic performance (Chemistry grades), particularly through LG. This means that students who have a higher level of learning satisfaction tend to perform better academically. PSHS CARC should leverage this connection by encouraging the use of LG to foster independent online learning, as it can potentially lead to improved academic outcomes.

Dominance of External Determinants

The study indicates that external determinants (such as the online learning platforms, teachers, and assessments) play a significant role in influencing student learning satisfaction. This suggests that the quality of these external factors has a substantial impact on how satisfied students are with their learning experiences.

Dominance of Internal Determinants

On the other hand, internal determinants (such as the student's attitude, motivation, information literacy, and metacognition) play a dominant role in influencing academic performance. This implies that a student's internal factors, mindset, and study habits can greatly affect their academic success.

Independence of Determinants

The study suggests that external and internal determinants operate somewhat independently of each other. This means that the factors that influence learning satisfaction might not necessarily be the same as those that influence academic performance. PSHS CARC should consider tailoring strategies and interventions to address these distinct determinants for the best results.

Implications for Future Strategies

The study's findings should serve as a foundation for shaping future learning strategies at PSHS CARC. Insights gained from this study can be used to adjust teaching methods, curriculum design, and online platform features to enhance both learning satisfaction and academic performance among Chemistry students.

Educational Policies and Interventions

The study recommends using its findings to guide the implementation of educational policies or intervention programs. These initiatives could focus on improving learning satisfaction and academic performance by addressing specific determinants identified in the study.

In summary, the implication of the results of this study provides valuable insights into the effectiveness of online learning platforms, the factors influencing learning satisfaction and academic performance, and how PSHS CARC can optimize its strategies for better outcomes among Chemistry students.

Recommendation

For PSHS-CARC, because the study is localized particularly with the PSHS CARC Chemistry students, the recommendation is to look at improving and taking advantage of the use of the Learning Guide (LG) and KHub as they were shown to directly affect the learning satisfaction of all PSHS CARC Chemistry students. One of those needing improvement with the LG is the creativity which means more illustrations can help in improving the learning guides, additional or longer time allotment for Chemistry subjects is needed to give more time to complete the activities, modularity (modules should not be very long, should be “bite-size”), and quantity (do not flood learners with lots of modules). To improve the KHub, stable and fast internet connectivity is a must for them to enjoy and be satisfied with learning by using this learning management system.

For the Chemistry teachers, the relatively low rating on the level of difficulty of assessment may be considered. The students find the assessment in their Chemistry subject to be very difficult. There have been complaints from students that their Chemistry is on the level of university/college students. While Chemistry is indeed a difficult subject, the level of the PSHS Chemistry course must be assessed by the Chemistry teachers and curriculum committee if it is an appropriate level for these young learners.

For the guidance and counseling committee of PSHS CARC, there might be a need to make more comprehensive data of the PSHS-CARC students on the internal determinants considered in this study. The internal determinants (ASC, AM, IL, and MW) were found to have a significant influence on the academic performance only for the Grade 10 students (but not for Grades 9, 11, and 12). This may need further investigating, especially ASC (academic self-concept).

For the Chemistry teachers and the curriculum program coordinators, there might be a need to resolve the claim of the students that the time allotted to complete assessment activities (assignments and requirements) is not reasonable at their Grade level. The effect of this (giving more time to complete assessment activities) is a reduction of activities or topics in a Grade level Chemistry course.

For PSHS-CARC, it is recommended to seriously consider the SLS Model and the Academic Performance Model that resulted in this study for making curriculum improvements and revisions in Chemistry at least for PSHS CARC. A further study involving a larger population (the whole PSHS system) is also recommended to see if the model is also applicable to a wider PSHS Chemistry student sample, to see if the model also applies to other Chemistry students in other PSHS campuses, or if the model may also apply for other subjects aside from Chemistry.

Area for Further Study

The following are several promising areas for further study that could contribute to a more comprehensive understanding of the dynamics within the realm of online education and its impact on learning satisfaction and academic performance:

Long-Term Effects and Sustainability

The immediate impact of online platforms on learning outcomes, delving into the long-term effects of sustained online education could provide valuable insights. Investigating how knowledge retention, skill development, and motivation evolve over time in an online learning environment would contribute to a more holistic understanding.

Digital Literacy and Skills

Understanding the role of digital literacy in online learning is crucial. Investigate how learners' varying degrees of digital proficiency influence their ability to navigate online platforms, interact with content, and engage with peers, ultimately affecting their learning outcomes.

Pedagogical Strategies

Diving deeper into the pedagogical approaches best suited for online learning could yield valuable insights. Investigate the effectiveness of problem-based learning, flipped classrooms, gamification, and other innovative methods in enhancing engagement and comprehension in the digital learning environment.

Technological Infrastructure

The quality of technological infrastructure can significantly impact the effectiveness of online education. Further exploration into how factors like internet access, device availability, and platform design influence students' ability to engage with educational content would be insightful.

Assessment Methods

Traditional assessment methods might not be ideal for evaluating online learning outcomes. Research alternative approaches such as project-based assessments, continuous evaluation, and competency-based assessments to ensure accurate measurement of skills and knowledge acquired. Assessments included in the LG can also be evaluated to determine its effectiveness for online learning.

Teacher and Facilitator Role

While your analysis covers the interplay of internal and external factors, a deeper understanding of the role of educators and facilitators in the online learning context is essential. Investigate how their guidance, interaction, and feedback impact students' learning experiences and outcomes.

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Appendices

APPENDIX A

APPROVAL OF THE CAMPUS DIRECTOR FOR THE CONDUCT OF THE STUDY

Republic of the Philippines
Department of Science and Technology
PHILIPPINE SCIENCE HIGH SCHOOL
CORDILLERA ADMINISTRATIVE REGION CAMPUS
Purok 12, Irisan, Baguio City
Email: ocd@carc.pshs.edu.ph

SOCOTEC ISO 9001

Premier science high school education begins at DOST-PSHS

May 16, 2022

PSHS-CAR Campus
Office of the Campus Director
RECEIVED
No. 2022-05-150 am
Date MAY 16 2022 By:

DR. CONRADO C. ROTOR, JR.
Campus Director
This Institution

Dear Sir,

Greetings!

I, a student at the University of the Philippines-Open University, will be conducting research titled ***"Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning"*** in fulfillment of the requirement for the degree of Doctor of Philosophy in Education, major in Chemistry Education. This study aims to answer the following problems:

1. Which of the following DETERMINANTS classified as external and internal factors have DIRECT influence in the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects?
   A. External factors (Teacher, Assessment tool, learning guide, Knowledge Hub)
   B. Internal factors (Age and Gender, Academic Self-concept, Academic Motivation, Interest to learn, well-being, academic performance)

2. Which of the DETERMINANTS have INDIRECT influence in the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects?

3. Which of the DETERMINANTS result in POSITIVE (Enjoyment) or NEGATIVE (Complaint) influence on the learning satisfaction of PSHS-CARC students enrolled Chemistry subjects?

4. What is the best SLS model that would represent the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects?

In relation to this, may I request permission to conduct validation of my survey questionnaires on Academic self-concept, Academic motivation, Interest to learn and well-being to be validated by the Guidance Counselors of the institution. Furthermore, may I also request permission to float the validated survey and the PSHS-CRBL survey questionnaire to our students enrolled in Chemistry subjects? Rest assured that ethical standard in conducting research will be implemented and the data gathered will be treated with confidentiality and will be used for my research only.

In addition, may I also request the help of the Chemistry teachers to administer the survey online (synchronous) using the free time of the students.

Approved:

CONRADO C. ROTOR, JR., Ph.D.
Campus Director/Director III

Respectfully yours,

Melba C. Patacsil
UPOU student

Noted by:

DR. MARIA ANA T. QUIMBO
Research adviser

Telephone No.: (074) 423-0126 Website: www.carc.pshs.edu.ph

APPENDIX B

PSHS-CARC RESEARCH ETHICS FULL ETHICAL REVIEW

Republic of the Philippines
Department of Science and Technology
PHILIPPINE SCIENCE HIGH SCHOOL
CORDILLERA ADMINISTRATIVE REGION CAMPUS
Purok 12, Irisan, Baguio City
Email: ocd@carc.pshs.edu.ph

SOCOTEC ISO 9001

Premier science high school education begins at DOST-PSHS

May 16, 2022

PSHS-CAR Campus
Office of the Campus Director
RECEIVED
No. 2022-05-150-CARC
Date MAY 1 6 2022 By.

Dr. Conrado C. Rotor, Jr
Campus Director
This Institution

Dear Sir,

The undersigned respectfully submits the hereto attached protocol for ethics review. My study titled *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning* will be conducted in partial fulfilment of the course *PhD Education major in Chemistry Education.* The study will be conducted in PSHS-CARC. Data gathering will commence this June 15, 2022.

Thank you very much.

Respectfully yours,

Melba C. Patacsil
Researcher

Noted by:

DR. MARIA ANA T. QUIMBO
Research adviser

Telephone No.: (074) 423-0126 Website: www.carc.pshs.edu.ph

DOST-PHILIPPINE SCIENCE HIGH SCHOOL SYSTEM
RESEARCH ETHICS
FULL ETHICAL REVIEW FORM

PART A. PROJECT SUMMARY
(To be provided by the Researcher/ applicant)

Full name of the Researcher	MELBA C. PATACSIL
Campus (If from PSHS)	CARC
Institution (If not from PSHS)	N/A
Researcher's role in the project	LEAD
Project lead (If not the project lead)	N/A
Contact email/mobile number	mcpatacsil@carc.pshs.edu.ph

Project title	Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning
Funding Institution	NONE
Other institution/Campuses/Individuals involved in the study	NONE
Expected start date	June, 2022
Expected end date	December 2022

Is the project /study part of study completion	☑ Yes ☐ No
If yes kindly provide the following	
a. Degree	Doctor of Philosophy in Education major in Chemistry Education
b. University	University of the Philippines-Open University
c. Research Adviser	Dr. Maria Ana T. Quimbo
d. Other members (if in a group)	N/A

PSHS-00-F-RPA-21-Ver02-Rev0-11/22/21

DOST-PHILIPPINE SCIENCE HIGH SCHOOL SYSTEM
RESEARCH ETHICS
FULL ETHICAL REVIEW FORM

PART B. APPLICATION CHECKLIST

Are the following documents supplied alongside this application?

1. Participant/Sample information sheet debriefing document	☑ Yes	☐ No
2. Participants' informed consent form	☑ Yes	☐ No
3. Parent/Legal guardian permit form (if the study involves students)	☑ Yes	☐ No
4. Letter/s of invitation to participants	☑ Yes	☐ No
5. Letter of permission (when access to participants/sample is not possible without the permission from an authorized person/institution	☑ Yes	☐ No
6. Questionnaires	☑ Yes	☐ No
a. Management of unsolicited information from the interviewee such as disclosure of information or behaviors or incidents observed. Interview will not implement in this research thus disclosure of information or behaviors or incidents will not be a problem.	☑ Yes	☐ No
b. Security of data (During and after the conduct of the study) The name of the participants will be withheld, students will be given individual code where they can use to answer the survey questionnaire. The collected data will be stored in a password protected computer. The results will only be shared in aggregate form. The digital files will be erased once the research is finish.	☑ Yes	☐ No
c. Method of transferring data within team The research is not group research thus the data will be kept by the researcher. Again, the collected data will be kept in a password protected computer. All files will be erased once the research is finish.	☑ Yes	☐ No
d. Managing data – sharing outside team Not applicable for this research. e. Measures to ensure confidentiality and curation	☑ Yes	☐ No
The parents or legal guardian will be asked to sign a parental consent where the objectives of the study were explained. The extend on how their child will participate in the study were also discussed. How the data will ~~keep~~ be kept was also emphasized in the consent. Participants will sign ~~a~~ an assent form. In this form, their participation was discussed and how their data will be collected and ~~keep~~ kept was explained. They may decline or withdraw their participation at	☑ Yes	☐ No

any time. Likewise, the student chooses not to participate or to withdraw from the study at any time, there will be no penalty. f. Others Please, specify _________	
8. Other (Please list)	☐ Yes ☐ No

PART C. PROJECT DETAILS

Please provide a brief paragraph to the following headings:

1. Project outline

a. Background of the study	The Covid-19 pandemic greatly disrupted the implementation of education programs worldwide. Most educational systems had to abruptly shift to online or remote learning in teaching pre-school up to tertiary level students. Online learning has become a useful and practical tool for curriculum delivery worldwide. The purpose of this research is to determine the factors (DETERMINANTS) of student learning satisfaction. This will, to a certain extent, address the effective way/s of delivering online lessons to students. Through the student learning satisfaction survey, educators, administrators, and other concerned stakeholders will be given insights for choosing the right tools to elevate the academic performance of students, design educational programs, initiate educational reforms, develop appropriate curriculum materials, conduct training for stakeholders, make necessary purchases, construct necessary facilities, and establish networks and linkages.
b. Research Questions or specific hypotheses to be tested	1. Which of the following DETERMINANTS classified as external and internal factors have DIRECT influence in the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects? A. external B. Internal 2. Which of the DETERMINANTS have INDIRECT influence in the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects? 3. Which of the DETERMINANTS result in POSITIVE (Enjoyment) or NEGATIVE (Complaint) influence on the learning satisfaction of PSHS-CARC students enrolled Chemistry subjects? 4. What is the best SLS model that would represent the learning satisfaction of PSHS-CARC students enrolled in Chemistry subjects?
c. Place of Study	Philippine science High School Cordillera Administrative Region Campus

2. Research Procedure

a. Design of the study	This study shall use the Correlational Research Design to investigate the relationships between variables (determinants of student learning satisfaction listed in Chapter II) without the researcher controlling or manipulating any of them. The correlation shall be determined to reflect the strength of the relationship between these variables and the learning satisfaction of the students. The process of this study is to uncover the SLS model by looking at significant correlations (using SmartPLS) – significant correlations between the chosen determinants and SLS and also significant correlations between one determinant and all other determinants. Hence, there is no predetermined model to be tested or verified but rather all possibilities will be considered. The final SLS model will be dictated by the significant correlations determined using the SmartPLS.
b. Procedures	The survey method, the most common method of correlational research, shall be used in this study. The subjects in this research (PSHS-CARC Chemistry students) will accomplish a survey questionnaire centered on their personal student learning satisfaction in relation to the determinants and separate questionnaires for Academic Self-concept, Academic motivation, mental well-being and Interest to learn The survey questionnaires adopted from research and psychological scales will be validated by guidance services associates first. The validated questionnaires shall be used to determine the correlation of the internal factors to student satisfaction. The CRBL survey questionnaires shall be used to know the correlation of the external; factors to the SLS model.
c. Test samples	The respondents of this study will be the Grade 9 to 12 students at Philippine Science High School Cordillera Administrative Region Campus enrolled during the School Year 2021-2022. The PSHS curriculum requires the following Chemistry courses for each Grade level: Grade 9 (Chemistry 1 – General Inorganic Chemistry 1), Grade 10 (Chemistry 2 – General Inorganic Chemistry 2), Grade 11 (Chemistry 3 – Reaction and Interaction of Organic and Inorganic Compounds) and Grade 12 (Chemistry 4 -Frontiers of Chemistry).
d. How the design of the study and the procedures followed are likely to assess the research questions or test the hypothesis in questions or establish significant result:	The study aims to build a model of student learning satisfaction in relation to the two factors categorized as external and internal factors in this study. The validated questionnaires will be the main assessment tools to answer the problems. SMARTPLS is the main statistical tools to assess the research questions.
e. Availability of facilities/ resources/ equipment	Resources and facilities needed are available.

DOST-PHILIPPINE SCIENCE HIGH SCHOOL SYSTEM
RESEARCH ETHICS
FULL ETHICAL REVIEW FORM

PART D. RESEARCH APPROVAL

Part D.1

1. Will this involve a participation of a. Student of PSHS? b. Faculty of PSHS c. Staff of PSHS If yes, how will anonymity be handled? The participants of the study will be assured of the confidentiality and anonymity of responses. The first page of all the CRBL survey questionnaires is a student's profile where the students identify his/her gender and grade level. His/her name is an" optional mode" of which he/she has an option to give information or not. It is the responsibility of the researcher not to include the name in the research. For the other survey questionnaires, participants will be assigned a code to assure confidentiality. The respondents, as part of the research will be able to access the result of the study once requested to the researcher.	 ☑ Yes ☐ No ☐ Yes ☑ No ☐ Yes ☑ No
2. Will this involve use of resources of PSHS? a. Facilities Specify: Wifi connectivity will be used during the synchronous survey gathering.	 ☑ Yes ☐ No
b. Equipment Specify:	☐ Yes ☑ No
c. Supplies Specify	☐ Yes ☑ No
d. Others Specify	☐ Yes ☑ No
3. Is the study conducted/Commissioned by another institution	☐ Yes ☑ No

- If you answered 'YES' to any of the questions above, this study requires approval from PSHS.Please attach a letter of request to the concerned Campus Director/s or to the PSHSS Executive Director.

no item 4

- If you answered 'YES' to no. 4, kindly answer Part D.2

PART D.2

1. Has this study been subjected to the ethical review? If yes, provide the findings of the review (submit the copy of the ethics review) ____________________ ____________________ ____________________ ____________________ If no, proceed to Part E.	☐ Yes	☑ No

PSHS-00-F-RPA-21-Ver02-Rev0-11/22/21

PART E GENERAL RESEARCH ETHICS CHECKLIST

1. Does your study have any ethical issues on any of the following?

a.	Human	☑ Yes	☐ No
b.	Animals	☐ Yes	☑ No
c.	Environment	☐ Yes	☑ No
d.	Data	☑ Yes	☐ No
e.	Others (Please list)	☐ Yes	☐ No

2. Does your study/research involve any of the following?

a.	Potentially vulnerable people (children, those with learning disability or cognitive impairment) or potentially vulnerable individuals in a dependent or unequal relationships.	☑ Yes	☐ No
b.	Person's incapable of giving inform consent.	☑ Yes	☐ No
c.	Body parts and other human elements.	☐ Yes	☑ No
d.	People who are identifiable by their membership	☐ Yes	☑ No
e.	Potentially sensitive topics (sexual behavior, illegal or political behavior, experience of violence, abuse or exploitation, mental health, personal or family lives, gender, or ethic status)	☐ Yes	☑ No
f.	Administrative or controlled data.	☑ Yes	☐ No
g.	Elite interviews (President of the Philippines, Head of org)	☐ Yes	☑ No
h.	Individuals or groups where permission is required for initial or continued access to participants.	☑ Yes	☐ No
i.	Social media and participants recruited or identified through the internet.	☐ Yes	☑ No
j.	Other visual/vocal methods, where participants or other individuals may be identifiable in the material.	☐ Yes	☑ No
k.	Protected areas/sites	☐ Yes	☑ No

3. Aside from the listed in number 1 and 2, will you have ethical issues on the following? (Please tick)

☑ Maximizing research benefits to participants or third parties
(Includes issues on sharing of ownership in case of innovation outputs, etc..

(Give specifics): Allowing UPOU to :
a) To upload a copy of the work in the theses database of the college/school/institute/department and in any other databases available on the public internet.

b) To publish the work in the college/school/institute/department journal, both in print and electronic or digital format and online; and

c) To give an open access to the above-mentioned work, thus allowing "fair use" of the work in accordance with the provisions of the intellectual Property Code of the Philippines (Republic Act No. 8293), especially for teaching, scholarly and research purposes."

(How to address) : As stated above UPOU will implement intellectual property code of ethics. The copy will not be allowed to be shared to everyone unless a request will be sent to UPOU and the researcher.

☑ Risks to research participants or third parties

(Give specifics): The data will be shared to UPOU

(How to address) : Information will be confidential, participants are assigned code numbers during the study that will be used during reporting of the data. The personal information is only accessed by the researcher who is doing the study.

☑ Risk to researchers

(Give specifics): The researcher might share the data. Citation of the research will happen without the knowledge of the researcher.

(How to address): The code will be used in reports, presentations, or publications and not the name of the participants. The collected data will be stored in a password protected computer. The results will only be shared in aggregate form. The digital files will be erased once the research is finish. Researcher cannot view the result of the research unless they will ask permission from UPOU or the researcher.

PART F. RESEARCH ETHICS REVIEW CRITERIA

CRITERIA FOR REVIEW (Instruction: Kindly check for the completeness and/or issues that might have an ethical use)	To be filled out by the reviewer		
	YES	NO	Comments and/or suggestions
Part A	✓		Completely accomplished
Part B	✓		Completely accomplished
Part C	✓		Completely accomplished
Part D			
Part E	✓		Completely accomplished
Recommended for ethical Clearance			Name and signature of reviewers: Member, Research Council PSHS-CARC Mr. Ricarido S. Saturay RIPO, Research Council PSHS-CARC

APPENDIX C

LETTER TO THE CONTENT VALIDATOR AND THEIR EVALUATIONS

May 16, 2022

Ms. Geraldine Orasing
Special Science Teacher III/Guidance Services Associate
This Institution

Dear Madam,

The undersigned is a student of the University of the Philippines-Open University, will be conducting research titled ***"Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning"*** In fulfillment of the requirement for the degree of Doctor of Philosophy in Education, major in Chemistry Education.

In connection with this, the researcher will be needing assistance regarding the validation of her questionnaires necessary for the study. Knowing that you are the most fit and capable to provide such, the undersigned has chosen and would like to ask approval from you to be the evaluator.

She is anticipating a favorable respond on this request.

Thank you very much and God bless you.

Sincerely yours,

Melba C. Patacsil
Researcher

Noted by:

Dr. Maria Ana T. Quimbo
Research adviser

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Geraldine Orosing

Designation: Special Science Teacher

School/Unit: Philippine Science High School - CAR Campus / [illegible]

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Academic Self-concept Scale	Rating
If I try hard enough, I will be able to get good grades	4
Because I try hard I do well in school.	4
I study hard so I expect to get a high score in exam.	4
All in all, I feel I am a capable student.	4
I do well in my courses given the amount of time I dedicate to studying.	4
I am satisfied with my grades in high school.	4
I view myself as intelligent.	4
My courses are very easy for me.	4
I feel like dropping out of school	4
My classmates do better in school than I do.	4
I am a good student.	4
I feel High school is too difficult for me.	4
All in all, I am proud of my grades in High school.	4
I feel confident while taking a test.	4
I feel capable of helping others with their class work.	4
I feel teachers' standards are too low for me.	3
It is easy for me to keep up with my class work.	4
I am satisfied with the class assignments that I turn in.	4
I feel like I accomplish a lot.	4
I feel I study enough before a test.	4
Exams are easy for me	4
I have doubts that I will do well in my subjects.	4
I have a hard time getting through school.	4
I am good at scheduling my study time.	4
I have a clear sense of my academic goals.	4
I'd like to be a better student than I am now.	4
I get encouraged about school.	4
I enjoy doing my homework.	4
I consider myself a very good student.	4
I get the grades I deserve in my courses	4
I study as much as I should	4
I feel that I am better than the average high school student.	4
In my courses, I feel that my classmates are better prepared than I am.	4
I feel that I have the necessary abilities for my subjects in my high school.	4
I have a very good study habit.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Geraldine Orasing

Designation: Special Science Teacher

School/Unit: Philippine Science High School - CAR campus / PSHS VALID

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale.

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Academic Motivation Scale	Rating
I want to have high grades in Chemistry (A)	4
I like it when my classmates listen to me when I discuss Chemistry. (S)	4
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	4
I know how to get the right resources to solve a question or problem in Chemistry. (A)	4
I experience satisfaction in learning new things in Chemistry. (S)	4
I believe I can solve any Chemistry question or problem. (A)	4
I experience pleasure in learning new things in Chemistry (S)	4
After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it. (A)	4
I feel smart when talking about my ideas that most people don't know about Chemistry. (S)	4
I like being competitive with other students in my Chemistry class. (S)	4
I want to have a career in Chemistry. (A)	4
Most of the time my efforts are rewarded (A)	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Geraldine L Orsig

Designation: Special Science Teacher

School/Unit: Philippine Science High School CAR Campus / PSHS VALID

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

- 4- Very relevant/Valid
- 3- Quite Relevant/Valid
- 2- Somewhat Relevant/Valid
- 1- Somewhat Relevant/ Not valid

Interest to learn scale	Rating
I generally have fun when I am learning Chemistry topics	4
I am happy solving Chemistry problems	4
I enjoy acquiring new knowledge in Chemistry	4
I am interested in learning about Chemistry	4
Learning Chemistry is important to me.	4
I find many applications of Chemistry in real life.	4
I really like Chemistry as a subject.	4
I want to discover new things in Chemistry I have never known before.	4
I like to read in advance before a Chemistry topic is discussed in class.	4
I would always strive to know the physical meaning of Chemistry equations.	4
I want to do research in Chemistry.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Geralaire Orading

Designation: Special Science teacher

School/Unit: Philippine Science High School - CAR Campus / PSHS-CARC

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Mental Well- Being Scale	Rating
I've been feeling optimistic about the future	4
I've been feeling useful	4
I've been feeling relaxed	4
I've been feeling interested in other people	4
I've had energy to spare	4
I've been dealing with problems well	4
I've been thinking clearly	4
I've been feeling good about myself	4
I've been feeling close to other people	4
I've been feeling confident	4
I've been able to make up my own mind about things	4
I've been feeling loved	4
I've been interested in new things	4
I've been feeling cheerful	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): ____________________

Designation: Special Science Teacher III

School/Unit: PSHS-CARC | PEHM VALID UNIT

Directions: Please validate the attached research instrument by selecting (putting a check mark) the best possible answer to each of the items of the questionnaire.

Academic Motivation Scale Intrinsic motivation only? How about extrinsic?	Rating Very Relevant/Valid (4)	Quite Relevant/Valid (3)	Somewhat Relevant/Valid (2)	NOT Relevant/Valid (1)	Remarks/ Suggestion
want to improve intellectual abilities in Chemistry I want to have high grades in Chemistry (A)	✓				
I like it when my classmates listen to me when I discuss Chemistry. (S)		✓			
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	✓				
I know how to get the right resources to solve a question or problem in Chemistry. (A)	✓				
sense of I experience pleasure and satisfaction in learning new things in Chemistry. (S)	✓				
I believe I can solve any Chemistry question or problem. (A) more on self confidence	✓				
After solving a problem in Chemistry, I want to explain how I solved it in class. (A)	✓				
I feel ~~smart~~ good when talking about my ideas that most people don't know about Chemistry. (S)	✓				
I like being competitive at the same time collaborate with other students in my Chemistry class. (S)	✓				
I want to have a career ~~in~~ related to Chemistry. (A)	✓				

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): ______________________

Designation: SST II

School/Unit: PEHM - VAL ED - PSHS - CARC

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Academic Self-concept Scale	Rating
If I try hard enough, I will be able to get good grades	4
Because I try hard I do well in school.	4
I study hard so I expect to get a high score in exam.	4
All in all, I feel I am a capable student.	4
I do well in my courses given the amount of time I dedicate to studying.	4
I am satisfied with my grades in high school.	4
I view myself as intelligent.	4
My courses are very easy for me.	4
I feel like dropping out of school	4
My classmates do better in school than I do.	4
I am a good student.	4
I feel High school is too difficult for me.	4
All in all, I am proud of my grades in High school.	4
I feel confident while taking a test.	4
I feel capable of helping others with their class work.	4
I feel teachers' standards are too low for me.	4
It is easy for me to keep up with my class work.	4
I am satisfied with the class assignments that I turn in.	4
I feel like I accomplish a lot.	4
I feel I study enough before a test.	4
Exams are easy for me	4
I have doubts that I will do well in my subjects.	4
I have a hard time getting through school.	4
I am good at scheduling my study time.	4
I have a clear sense of my academic goals.	4
I'd like to be a better student than I am now.	4
I get encouraged about school.	4
I enjoy doing my homework.	4
I consider myself a very good student.	4
I get the grades I deserve in my courses	4
I study as much as I should	4
I feel that I am better than the average high school student.	4
In my courses, I feel that my classmates are better prepared than I am.	4
I feel that I have the necessary abilities for my subjects in my high school.	4
I have a very good study habit.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Irem Alcantara

Designation: SST 2

School/Unit: PEHM- VAL ED UNIT - PSHS- CARC

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale.

- **4- Very relevant/Valid**
- **3- Quite Relevant/Valid**
- **2- Somewhat Relevant/Valid**
- **1- Somewhat Relevant/ Not valid**

Academic Motivation Scale	**Rating**
I want to have high grades in Chemistry (A)	4
I like it when my classmates listen to me when I discuss Chemistry. (S)	4
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	4
I know how to get the right resources to solve a question or problem in Chemistry. (A)	4
I experience satisfaction in learning new things in Chemistry. (S)	4
I believe I can solve any Chemistry question or problem. (A)	4
I experience pleasure in learning new things in Chemistry (S)	4
After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it. (A)	4
I feel smart when talking about my ideas that most people don't know about Chemistry. (S)	4
I like being competitive with other students in my Chemistry class. (S)	4
I want to have a career in Chemistry. (A)	4
Most of the time my efforts are rewarded (A)	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Irene T. Alcantara

Designation: SST II

School/Unit: PEHM-VALED - PSHS-CARC

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Interest to learn scale	Rating
I generally have fun when I am learning Chemistry topics	4
I am happy solving Chemistry problems	4
I enjoy acquiring new knowledge in Chemistry	4
I am interested in learning about Chemistry	4
Learning Chemistry is important to me.	4
I find many applications of Chemistry in real life.	4
I really like Chemistry as a subject.	4
I want to discover new things in Chemistry I have never known before.	4
I like to read in advance before a Chemistry topic is discussed in class.	4
I would always strive to know the physical meaning of Chemistry equations.	4
I want to do research in Chemistry.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Irene T. Alcantara

Designation: SST II

School/Unit: PEHM. VAL DD - PSHS-CVRC

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Mental Well- Being Scale	Rating
I've been feeling optimistic about the future	4
I've been feeling useful	4
I've been feeling relaxed	4
I've been feeling interested in other people	4
I've had energy to spare	4
I've been dealing with problems well	4
I've been thinking clearly	4
I've been feeling good about myself	4
I've been feeling close to other people	4
I've been feeling confident	4
I've been able to make up my own mind about things	4
I've been feeling loved	4
I've been interested in new things	4
I've been feeling cheerful	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Rey B. Tripuka

Designation: Guidance Services Associate

School/Unit: PSHS - CAR Campus / Guidance & Counseling Unit

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Academic Self-concept Scale	Rating
If I try hard enough, I will be able to get good grades	4
Because I try hard I do well in school.	4
I study hard so I expect to get a high score in exam.	4
All in all, I feel I am a capable student.	3
I do well in my courses given the amount of time I dedicate to studying.	4
I am satisfied with my grades in high school.	3
I view myself as intelligent.	2
My courses are very easy for me.	3
I feel like dropping out of school	3
My classmates do better in school than I do.	2
I am a good student.	4
I feel High school is too difficult for me.	3
All in all, I am proud of my grades in High school.	4
I feel confident while taking a test.	4
I feel capable of helping others with their class work.	4
I feel teachers' standards are too low for me.	2
It is easy for me to keep up with my class work.	3
I am satisfied with the class assignments that I turn in.	4
I feel like I accomplish a lot.	3
I feel I study enough before a test.	3
Exams are easy for me	3
I have doubts that I will do well in my subjects.	3
I have a hard time getting through school.	4
I am good at scheduling my study time.	4
I have a clear sense of my academic goals.	4
I'd like to be a better student than I am now.	4
I get encouraged about school.	4
I enjoy doing my homework.	3
I consider myself a very good student.	4
I get the grades I deserve in my courses	4
I study as much as I should	4
I feel that I am better than the average high school student.	3
In my courses, I feel that my classmates are better prepared than I am.	2
I feel that I have the necessary abilities for my subjects in my high school.	4
I have a very good study habit.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Rey B. Tripulca

Designation: Guidance Services Associate

School/Unit: PSHS-CAR Campus / Guidance & Counseling Unit

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Academic Motivation Scale	Rating
I want to have high grades in Chemistry (A)	4
I like it when my classmates listen to me when I discuss Chemistry. (S)	3
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	3
I know how to get the right resources to solve a question or problem in Chemistry. (A)	4
I experience satisfaction in learning new things in Chemistry. (S)	4
I believe I can solve any Chemistry question or problem. (A)	4
I experience pleasure in learning new things in Chemistry (S)	4
After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it. (A)	4
I feel smart when talking about my ideas that most people don't know about Chemistry. (S)	3
I like being competitive with other students in my Chemistry class. (S)	2
I want to have a career in Chemistry. (A)	4
Most of the time my efforts are rewarded (A)	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Rey B. Tripulca

Designation: Guidance Services Associate

School/Unit: PSHS-CAR Campus/ Guidance & Counseling Unit

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Interest to learn scale	Rating
I generally have fun when I am learning Chemistry topics	4
I am happy solving Chemistry problems	4
I enjoy acquiring new knowledge in Chemistry	4
I am interested in learning about Chemistry	4
Learning Chemistry is important to me.	4
I find many applications of Chemistry in real life.	4
I really like Chemistry as a subject.	4
I want to discover new things in Chemistry I have never known before.	4
I like to read in advance before a Chemistry topic is discussed in class.	4
I would always strive to know the physical meaning of Chemistry equations.	4
I want to do research in Chemistry.	4

Evaluation Sheet for Content Validity

Title of Research: *Determinants of Student Learning Satisfaction in High School Chemistry: A Prediction Model Building Study for Online Learning*

Name (Optional): Rey B. Tripulca

Designation: Guidance Services Associate

School/Unit: PSHS-CARC / Guidance & Counseling Unit

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

4- Very relevant/Valid
3- Quite Relevant/Valid
2- Somewhat Relevant/Valid
1- Somewhat Relevant/ Not valid

Mental Well- Being Scale	Rating
I've been feeling optimistic about the future	4
I've been feeling useful	4
I've been feeling relaxed	4
I've been feeling interested in other people	4
I've had energy to spare	4
I've been dealing with problems well	4
I've been thinking clearly	4
I've been feeling good about myself	4
I've been feeling close to other people	4
I've been feeling confident	4
I've been able to make up my own mind about things	4
I've been feeling loved	4
I've been interested in new things	4
I've been feeling cheerful	4

APPENDIX D

ASSENT FORM

My name is Melba C. Patacsil. I am one of your Chemistry teachers and a student at University of the Philippines-Open University. I am inviting you to participate in a research study about prediction model building study for online learning. Your parent(s) know we are talking with you about the study. This form will tell you about the study to help you decide whether you want to take part in it.

What is the key information about this research study?

The following is a short summary of this study to help you decide whether you want to be a part of this study.

The online learning that we implemented challenged each one of you. One problem that I notice is the difficulty in learning concept of Chemistry. Based on the survey conducted by the PSHS system, external and internal factors affect your learning satisfaction. This is the reason why I consider studying: predicting a model of student learning satisfaction.

The purpose of this study is to produce a specific model in predicting the factors affecting student learning satisfaction in PSHS CAR campus. Being able to determine which of the factors (External and Internal factors) have significantly influenced the student learning satisfaction in a positive direction will guide the teachers and administrators to enhance these practices while those factors that influence negatively may be eliminated or be improved upon. You will be asked to complete a survey on student learning satisfaction, academic self-concept, academic motivation, interest to learn and mental well-being. I expect that you will be in this research study for one hour. The Chemistry teachers will help me implement the research through synchronous collection of data. As the researcher, I do not find any risk that may come with your participation. The main benefit is you will help me provide the model that will help the administrator what factors they will enhance to provide a better learning environment in an online learning.

Why is this study being done?

The purpose of the study is to know the external and internal factors that affect student learning satisfaction. If you will help me identify these factors, this will aid the Chemistry unit and the administration to implement changes in the curriculum, learning materials, assessment and learning management system. You are being asked to take part in the study because you become a part of the online learning of PSHS-CARC and part of the Chemistry curriculum.

What do I need to do?

If you decide to be in the study, I will ask you to answer the survey questionnaire honestly. Your identity will be kept confidential. Before asking you to answer the survey questionnaire, I will send a code and you will use this code instead of writing your name. You will be asked to answer the survey questionnaire for an hour. A link of our synchronous meeting will be sent a day before the synchronous meeting.

What are the benefits to me?

If you take part in this study, you will help the teachers in Chemistry understand their students. They will also know what to enhance to help you understand Chemistry concepts. Taking part of the survey will also guide the administration to implement a policy based on the result of the research.

Are there any risks to me if I decide to be involved in this study?

There are no foreseeable risks however some of you may find inconveniences like fatigue, boredom or anxiety when taking the survey. I suggest that you feel free to tell me if you become tired so we can take a short break.

APPENDIX E

PARENTAL CONSENT FORM

INVITATION TO PARTICIPATE:

Dear Parent/Legal guardian,

My name is Melba C. Patacsil and I am currently the Curriculum Instruction Division Chief of Philippine Science High school Cordillera Administrative Region campus. I am conducting a research study to identify the factors that affect the learning satisfaction of your child. The purpose of this form is to provide you with information that will help you decide if you will give consent for your child to participate in this research.

KEY INFORMATION ABOUT THIS RESEARCH STUDY:

The following is a short summary of this study to help you decide whether you want your child to be a part of this study.

The purpose of this study is to produce a specific model in predicting the factors affecting student learning satisfaction in PSHS CAR campus. Being able to determine which of the factors (External and Internal factors) have significantly influenced the student learning satisfaction in a positive direction will guide the teachers and administrators to enhance these practices while those factors that influence negatively may be eliminated or be improved upon. Your child will be asked to complete a survey on student learning satisfaction, academic self-concept, academic motivation, interest to learn and mental well-being. I expect that your child will be in this research study for an hour just to answer the survey questionnaires. The main benefit of your child is they can tell the administrations what are the factors that need to be prioritized especially during online learning.

STUDY PURPOSE:

The purpose of this study is to give immediate feedback to the administration on the factors that affect your child's learning satisfaction during the online learning. With our present condition, where normalcy is not yet stable, this research will guide us on how to implement the online learning of your child for the next school year. In this way, we can help each other to build the confidence of your child again.

NUMBER OF PARTICIPANTS:

If you agree to participate, your child will be one of the two hundred fifty (250) participants who will be participating in this research.

PROCEDURES FOR THE STUDY:

If you agree for your child to participate in the study, s/he will be answering a survey questionnaire for an hour through an online synchronous meeting. S/he will be guided by the chemistry teachers during the collection of data. Your child identity will be kept confidential where his or her name will be optional in answering the survey questionnaires. Data that will be gathered will be used for this research only. Future research studies may request consent to the University of the Philippines -Open University and to the researcher before it will be used. Rest assured that the identity of your child will be kept confidential even during the data analysis and reporting of results.

RISKS AND INCONVENIENCES:

There are minimal risks and inconveniences to participating in this study. These include:

1. Your child may be uncomfortable answering the survey questionnaires.

2. S/he might feel bored when answering the survey questionnaires for an hour.

SAFEGUARDS:

To minimize these risks and inconveniences, the following measures will be taken:

1. Your child will be guided by the Chemistry teachers when taking the survey.
2. The collection of data will be one hour only.
3. In times that your child needs a short break, the teacher in charge will allow him/her to take a break.
4. The child can skip any questions that s/he feels uncomfortable answering while taking the survey.

CONFIDENTIALITY:

Your child's responses or information will be confidential; participants are assigned code numbers during the study. Use of the code will be used during reporting of the data. The personal information is only accessed by the researcher who is doing the study.

The results of this study may be used in reports, presentations, or publications but your child's name will not be used. The collected data will be stored in a password protected computer. The results will only be shared in aggregate form. The digital files will be erased once the research is finished.

VOLUNTARY PARTICIPATION:

Your child's participation in this study is voluntary. Your child may decline participation at any time. You may also withdraw your child from the study at any time; there will be no penalty not even affecting the grade of your child. Likewise, if your child chooses not to participate or to withdraw from the study at any time, there will be no penalty.

BENEFITS OF TAKING PART IN THE STUDY:

The benefits of your child participating in this study are the main concern of this study. Knowing the student learning satisfaction model in every grade level will help the administration how to cater the needs of your child during online learning. Similarly, the chemistry teachers will also know what type of assessment, teaching strategies as well as instructional materials is important in the learning journey of your child. Working together to lift your child's confidence as PSHS scholar and giving a quality education is the common goal of parents and PSHS administration.

CONTACT INFORMATION:

If you have questions about the study, please email me at
mcptacsil@carc.pshs.edu.ph .

PARENT'S CONSENT:

By signing below, you are giving consent for your child to participate in the above study. Please check the option that applies to you before signing:

☐ I give permission for my child to participate in the study

☐ I do not give permission for my child to participate in the study.

Your child's name: ________________________________

Parent's name: _____________________________________

Parent's Signature: _________________________________

Date: ________________________

APPENDIX F

DEBRIEF SHEET

Title of research:
Name of Researcher: Melba C. Patacsil

Thank you for taking part in this study. The sheet will provide you with full details of the study in which you participated.

The adaptation of many schools to online learning due to the pandemic changed the implementation of the learning process. The abrupt change affects student satisfaction which is the most crucial factor affecting the quality of education. For the past two years of implementing online learning, many schools are busy identifying appropriate instructional materials, updating software, and sending teachers to attend seminars and training to be equipped and cope with the change. Though these moves are important, the question of whether they really identify the right instructional materials or bought the needed software and even the right training and seminars in equipping teachers remain to be answered.

This study will particularly produce a specific model in predicting the factors affecting student learning satisfaction in PSHS CAR campus. Being able to determine which of the factors (External and Internal factors) have significantly influenced the student learning satisfaction in a positive direction will guide the teachers and administrators to enhance these practices while those factors that influence negatively may be eliminated or be improved upon.

You will be asked to answer survey questionnaires that will lead the researcher to produce a model on student learning satisfaction per grade level (Grade 9-12) in Chemistry subject. The survey questionnaires that will be included were validated and can measure your learning satisfaction based on your academic performance, academic self-concept, academic motivation, interest to learn and mental well-being. In addition, your experience in using the learning guides, KHub, synchronous and asynchronous learning, assessment and teachers' pedagogical skills will also help in the production of the model. This task is given to all participants, and I hope that you can answer the survey questionnaire seriously because this will help the administrator to implement better online learning.

Thank you again for taking part. If there is anything you would like to discuss in relation to this study, please feel free to do so by contacting the researcher. If you would like to withdraw your data, please speak to the researcher now or contact him/her later. The researcher has written your anonymity code on your information sheet. As your data is identified only by this code, you will have to quote it if you want your data to be destroyed later, so please take care not to lose this sheet.

Name of researcher: Melba C. Patacsil

Email address: mcpatacsil@carc.pshs.edu.ph

APPENDIX G

STUDENT SATISFACTION SURVEY

STUDENT'S PROFILE

Name (Optional): ______________________________
Grade Level: _________________________________
Gender (M or F): ______________________________

A. Teacher Satisfaction Survey

Please indicate your level of satisfaction with your teacher by indicating the number which corresponds to your response using the following scale:

5 - Strongly satisfied
4 - Satisfied
3 - Neutral
2 – Unsatisfied
1 – Strongly Unsatisfied

Teacher factor Indicator	Rating
My teacher has a thorough knowledge of the subject content.	
My teacher communicated the subject content effectively.	
Punctuality in synchronous sessions	
Timeliness in returning outputs	
Timeliness in giving feedbacks	
Considerate /Understanding	
Fairness	
Availability for consultation	

Below are questions that request for your honest responses based on your experiences with your Chemistry teacher:

1. Which of the teacher factor indicators positively affect your learning satisfaction the most? Why?

____

____

2. Which of the teacher factor indicators negatively affect your learning satisfaction the most? Why?

____

____

B. Assessment Satisfaction Survey

Please indicate your level of satisfaction with your assessment by indicating the number which corresponds to your response using the following scale:

5 - Strongly satisfied
4 - Satisfied
3 - Neutral
2 – Unsatisfied
1 – Strongly Unsatisfied

Assessment Indicator	Rating
Level of difficulty	
Level of engagement	
Format of activities or outputs	
Length of activities	
Instruction on the process	
Number of assessment/activities	
Duration of deadlines	

Below are questions that request for your honest responses based on the given assessment of your Chemistry teacher.

1. Which of the assessment factor indicators positively affect your learning satisfaction the most? Why?

____

____

2. Which of the teacher factor indicators negatively affect your learning satisfaction the most? Why?

____

____

C. Leaning Guides (LG) Satisfaction Survey

Please indicate your level of satisfaction with your learning guides by indicating the number which corresponds to your response using the following scale:

5 - Strongly satisfied
4 - Satisfied
3 - Neutral
2 – Unsatisfied
1 – Strongly Unsatisfied

Learning Guide Indicator	Rating
Clarity	
Creativity	
Completeness of the content	
Time allotment	
Modularity (bite-sized, etc.)	
Quantity (no. of LGs, no. of topics, etc.)	

Below are questions that request for your honest responses on your overall satisfaction of the learning guides.

1. Which of the learning guide indicators positively affect your learning satisfaction the most? Why?

____
____

2. Which of the learning guide indicators negatively affect your learning satisfaction the most? Why?

____
____

D. **Learning Management System: Knowledge hub (KHub) satisfaction Survey**

Please indicate your level of satisfaction in using the learning management system of PSHS (KHub) indicating the number which corresponds to your response using the following scale:

5 - Strongly satisfied
4 - Satisfied
3 - Neutral
2 – Unsatisfied
1 – Strongly Unsatisfied

LMS: KHub Indicator	Rating
Accessibility	
Response Time	
Ease of navigation	
Ease of Use	
Notification features	

Below are questions that request for your honest responses on your overall satisfaction of the learning management system (KHub).

1. Which of the Khub indicators positively affect your learning satisfaction the most? Why?

____
____
____

2. Which of the Khub indicators positively affect your learning satisfaction the most? Why?

____
____
____

E. The Overall Satisfaction with the four factors (teacher, assessment, LG and KHub)

Please indicate your overall level of satisfaction indicating the number which corresponds to your response using the following scale:

5 - Strongly satisfied
4 - Satisfied
3 - Neutral
2 – Unsatisfied
1 – Strongly Unsatisfied

Learning Satisfaction Indicator (Overall)	**Rating**
Teacher satisfaction	
Assessment satisfaction	
Learning Guide satisfaction	
KHub satisfaction	

Based on your experience during the online learning give your honest response in the following questions:

1. Which of the above learning satisfaction indicators motivates you? Why?

2. Which of them needs to be enhanced? Why?

APPENDIX H

ACADEMIC SELF-CONCEPT SCALE

Instructions:

This questionnaire deals with attitudes, feelings and thoughts that people have about themselves. Since people vary so much in the opinions they hold, there are no right or wrong answers.
Please indicate how much you agree or disagree with each statement by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Academic Self-concept Scale	Rating
If I try hard enough, I will be able to get good grades	
Because I try hard I do well in school.	
I study hard so I expect to get a high score on the exam.	
All in all, I feel I am a capable student.	
I do well in my courses given the amount of time I dedicate to studying.	
I am satisfied with my grades in high school.	
I view myself as intelligent.	
My courses are very easy for me.	
I feel like dropping out of school	
My classmates do better in school than I do.	
I am a good student.	
I feel High school is too difficult for me.	
All in all, I am proud of my grades in High school.	
I feel confident while taking a test.	
I feel capable of helping others with their class work.	
I feel teachers' standards are too low for me.	
It is easy for me to keep up with my class work.	
I am satisfied with the class assignments that I turn in.	
I feel like I accomplish a lot.	

I feel I study enough before a test.	
Exams are easy for me	
I have doubts that I will do well in my subjects.	
I have a hard time getting through school.	
I am good at scheduling my study time.	
I have a clear sense of my academic goals.	
I'd like to be a better student than I am now.	
I get encouraged about school.	
I enjoy doing my homework.	
I consider myself a very good student.	
I get the grades I deserve in my courses	
I study as much as I should	
I feel that I am better than the average high school student.	
In my courses, I feel that my classmates are better prepared than I am.	
I feel that I have the necessary abilities for my subjects in my high school.	
I have a very good study habit.	

APPENDIX I

ACADEMIC MOTIVATION SCALE

Instructions:

This questionnaire deals with attitudes, feelings and thoughts that people have about themselves. Since people vary so much in the opinions they hold, there are no right or wrong answers.

Please indicate how much you agree or disagree with each statement by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Academic Motivation Scale	Rating
I want to have high grades in Chemistry (A)	
I like it when my classmates listen to me when I discuss Chemistry. (S)	
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	
I know how to get the right resources to solve a question or problem in Chemistry. (A)	
I experience satisfaction in learning new things in Chemistry. (S)	
I believe I can solve any Chemistry question or problem. (A)	
I experience pleasure in learning new things in Chemistry (S)	
After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it. (A)	
I feel smart when talking about my ideas that most people don’t know about Chemistry. (S)	
I like being competitive with other students in my Chemistry class. (S)	
I want to have a career in Chemistry. (A)	
Most of the time my efforts are rewarded (A)	

APPENDIX J

INTEREST TO LEARN SCALE

Instructions

This questionnaire deals with attitudes, feelings and thoughts that people have about themselves. Since people vary so much in the opinions they hold, there are no right or wrong answers.

Please indicate how much you agree or disagree with each statement by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Interest to learn scale	**Rating**
I generally have fun when I am learning Chemistry topics	
I am happy solving Chemistry problems	
I enjoy acquiring new knowledge in Chemistry	
I am interested in learning about Chemistry	
Learning Chemistry is important to me.	
I find many applications of Chemistry in real life.	
I really like Chemistry as a subject.	
I want to discover new things in Chemistry I have never known before.	
I like to read in advance before a Chemistry topic is discussed in class.	
I would always strive to know the physical meaning of Chemistry equations.	
I want to do research in Chemistry.	

APPENDIX K

MENTAL WELL-BEING SCALE

Instructions

This questionnaire deals with attitudes, feelings and thoughts that people have about themselves. Since people vary so much in the opinions they hold, there are no right or wrong answers.

Please indicate how much you agree or disagree with each statement by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Mental Well- Being Scale	Rating
I've been feeling optimistic about the future	
I've been feeling useful	
I've been feeling relaxed	
I've been feeling interested in other people	
I've had energy to spare	
I've been dealing with problems well	
I've been thinking clearly	
I've been feeling good about myself	
I've been feeling close to other people	
I've been feeling confident	
I've been able to make up my own mind about things	
I've been feeling loved	
I've been interested in new things	
I've been feeling cheerful	

APPENDIX L

Evaluation Sheet for Content Validity
ACADEMIC SELF-CONCEPT SCALE

Title of Research: *Partial Least Square Structural Equation Model (PLS-SEM) of the Student Learning Satisfaction and Academic Performance of PSHS-CARC High School Chemistry Online Learners*.

Name of Evaluator ____

Designation: ____

School/Unit: ____

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Academic Self-concept Scale	Rating
If I try hard enough, I will be able to get good grades	
Because I try hard I do well in school.	
I study hard so I expect to get a high score on the exam.	
All in all, I feel I am a capable student.	
I do well in my courses given the amount of time I dedicate to studying.	
I am satisfied with my grades in high school.	
I view myself as intelligent.	
My courses are very easy for me.	
I feel like dropping out of school	
My classmates do better in school than I do.	
I am a good student.	
I feel High school is too difficult for me.	
All in all, I am proud of my grades in High school.	
I feel confident while taking a test.	
I feel capable of helping others with their class work.	
I feel teachers' standards are too low for me.	

It is easy for me to keep up with my class work.	
I am satisfied with the class assignments that I turn in.	
I feel like I accomplish a lot.	
I feel I study enough before a test.	
Exams are easy for me	
I have doubts that I will do well in my subjects.	
I have a hard time getting through school.	
I am good at scheduling my study time.	
I have a clear sense of my academic goals.	
I'd like to be a better student than I am now.	
I get encouraged about school.	
I enjoy doing my homework.	
I consider myself a very good student.	
I get the grades I deserve in my courses	
I study as much as I should	
I feel that I am better than the average high school student.	
In my courses, I feel that my classmates are better prepared than I am.	
I feel that I have the necessary abilities for my subjects in my high school.	
I have a very good study habit.	

APPENDIX M

Evaluation Sheet for Content Validity

ACADEMIC MOTIVATION SCALE

Title of Research: *Partial Least Square Structural Equation Model (PLS-SEM) of the Student Learning Satisfaction and Academic Performance of PSHS-CARC High School Chemistry Online Learners*.

Name of Evaluator: ______________________________
Designation: ______________________________
School/Unit: ______________________________

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Academic Motivation Scale	Rating
I want to have high grades in Chemistry (A)	
I like it when my classmates listen to me when I discuss Chemistry. (S)	
I like to hear appreciative words from my Chemistry teacher for sharing things I know in Chemistry(S)	
I know how to get the right resources to solve a question or problem in Chemistry. (A)	
I experience satisfaction in learning new things in Chemistry. (S)	
I believe I can solve any Chemistry question or problem. (A)	
I experience pleasure in learning new things in Chemistry (S)	
After solving a problem in Chemistry, I want to explain how I solved it in class to help my classmate understand it. (A)	
I feel smart when talking about my ideas that most people don't know about Chemistry. (S)	
I like being competitive with other students in my Chemistry class. (S)	
I want to have a career in Chemistry. (A)	
Most of the time my efforts are rewarded (A)	

APPENDIX N

Evaluation Sheet for Content Validity

INTEREST TO LEARN SCALE

Title of Research: *Partial Least Square Structural Equation Model (PLS-SEM) of the Student Learning Satisfaction and Academic Performance of PSHS-CARC High School Chemistry Online Learners*

Name of Evaluator: ____
Designation: ____
School/Unit: ____

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

Interest to learn scale	Rating
I generally have fun when I am learning Chemistry topics	
I am happy solving Chemistry problems	
I enjoy acquiring new knowledge in Chemistry	
I am interested in learning about Chemistry	
Learning Chemistry is important to me.	
I find many applications of Chemistry in real life.	
I really like Chemistry as a subject.	
I want to discover new things in Chemistry I have never known before.	
I like to read in advance before a Chemistry topic is discussed in class.	
I would always strive to know the physical meaning of Chemistry equations.	
I want to do research in Chemistry.	

APPENDIX O

Evaluation Sheet for Content Validity

MENTAL WELL-BEING SCALE

Title of Research: *Partial Least Square Structural Equation Model (PLS-SEM) of the Student Learning Satisfaction and Academic Performance of PSHS-CARC High School Chemistry Online Learners*.

Name of Evaluator ______________________________

Designation: ______________________________

School/Unit: ______________________________

Directions: Please validate the attached research instrument by indicating the number which corresponds to your response using the following scale:

5 - Strongly agree
4 - Agree
3 - Neutral
2 – Disagree
1 – Strongly disagree

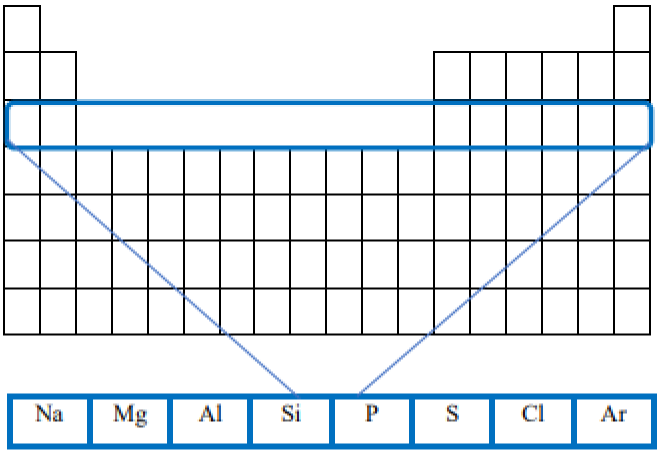
Mental Well- Being Scale	Rating
I’ve been feeling optimistic about the future	
I’ve been feeling useful	
I’ve been feeling relaxed	
I’ve been feeling interested in other people	
I’ve had energy to spare	
I’ve been dealing with problems well	
I’ve been thinking clearly	
I’ve been feeling good about myself	
I’ve been feeling close to other people	

I've been feeling confident	
I've been able to make up my own mind about things	
I've been feeling loved	
I've been interested in new things	
I've been feeling cheerful	

A Sample Learning Guide Module

PROPERTY OF THE PHILIPPINE SCIENCE HIGH SCHOOL SYSTEM

Subject Code	Chemistry 3	Reactions and Interactions of Organic and Inorganic Compounds
Module Code	6.0	Periodic Table: Guide to Chemistry Elements
Lesson Code	6.1	Periodicity of physical properties of elements in the third period
Time Limit		30 minutes

Components	Tasks	TA[a]	AT A[b]
Target 	By the end of this learning guide module, the students should be able to: 1. Describe qualitatively the variations in atomic radius, ionic radius, first ionization energy, melting point and electrical conductivity of the third period elements 2. Compare and contrast the variation in melting point and electrical conductivity of simple molecular and and giant molecular structures.	0.5min	
Hook 	In Chemistry 1, you learned that the elements in the modern periodic table are arranged in order of increasing atomic number in horizontal rows called **periods** and in vertical columns known as **groups or families.** Look at period 3 elements in figure 1. What do these elements have in common?  Figure 1. Period 3 elements Let's write the electronic configuration of each element: Na $[Ne]\ 3s^1$ Mg $[Ne]\ 3s^2$ Al $[Ne]\ 3s^2\ 3p_x^1$ Si $[Ne]\ 3s^2\ 3p_x^1\ 3p_y^1$ P $[Ne]\ 3s^2\ 3p_x^1\ 3p_y^1\ 3p_z^1$ S $[Ne]\ 3s^2\ 3p_x^2\ 3p_y^1\ 3p_z^1$	3 min	

<table>
<tr>
<td></td>
<td>Cl [Ne] $3s^2\ 3p_x^2\ 3p_y^2\ 3p_z^1$

Ar [Ne] $3s^2\ 3p_x^2\ 3p_y^2\ 3p_z^2$

Notice that the outermost energy level of these elements is 3, however they differ in valence electron. Considering these electron configurations, how would you expect atomic and physical properties of period 3 elements to vary?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ignite</td>
<td>In this learning guide, variation in atomic radius, ionic radius, first ionization energy, melting point and electrical conductivity of period 3 elements will be described and explained.

Variation in Atomic Radius

Trend: Decreases from left to right of the periodic table of elements.

Figure 2. Atomic radii of period 3 elements

Explanation: Atomic radius is one-half the distance between the two nuclei in two adjacent metal atoms or in a diatomic molecule. The number of protons from Na to Ar increases, however the valence electrons are all in the 3rd energy level (see electron configuration), hence the attraction between the nucleus and the electrons increases. So the atomic radius decreases.

Variation in Ionic Radius

Trend: Atom forms an anion, its size (or radius) increases.

Atom forms a cation, its size (or radius) decreases.

Figure 3. The ionic radii (in picometers) of some period 3 elements.</td>
<td>15 min</td>
<td></td>
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</table>

Explanation: Ionic radius is the radius of a cation or an anion. Anion is larger than its atom because the nuclear charge remains the same but the repulsion resulting from the additional electron(s) enlarges the domain of the electron cloud. Cation is smaller than its atom because the electron-electron repulsion decreases but the nuclear charge remains the same, so the electron cloud shrinks.

Figure 3 shows the changes in size that result when Na, Mg and Al are converted to cations and S and Cl are converted to anions. Mg^{2+} and Na^{+} have the same number of electrons however Mg^{2+} has one more proton. Thus, the electron cloud in Mg^{2+} is pulled inward more than that in Na^{+}.

Variation in First Ionization Energy

Trend: Increases from left to right of the periodic table of elements.

Table 1. The First Ionization Energies of Period 3 elements

Element	Number of Protons	First Ionization energy (kJ/mole)
Sodium	11	495.9
Magnesium	12	738.1
Aluminum	13	577.9
Silicon	14	786.3
Phosphorous	15	1,012
Sulfur	16	999.5
Chlorine	17	1,251
Argon	18	1,521

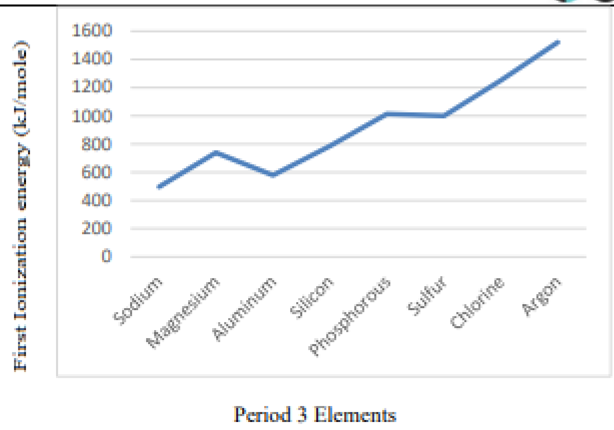


Figure 4. Graph of first ionization energies of period 3 elements

Explanation: First ionization energy is the amount of energy required to remove the first electron from the atom in its ground state. It is generally increases across Period 3 however, it drops at aluminium and Sulfur (Table 1 and Figure 4). This is because the electronic structures of the two elements are more stable after loosing 1 electron.

The electronic structure of Al^+, for example, with a full $3s^2$ orbital is more stable than that of Al with incomplete $3p^1$ orbital.

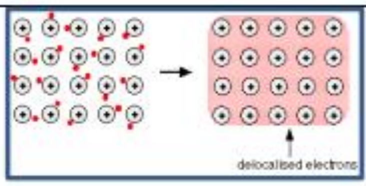
$$Al\,[3s^2 3p^1] \rightarrow Al^+[3s^2] + e$$

Physical Properties

There is a transition from metals to metalloid to nonmetals across period 3 elements. Sodium, the first element in the third period, is a very reactive metal, whereas chlorine, the second-to-last element of that period, is a very reactive nonmetal. In between, the elements show a gradual transition from metallic properties to nonmetallic properties.

Sodium, magnesium, and aluminum all have extensive three-dimensional atomic networks, which are held together by forces characteristic of the metallic state. In sodium, only one electron per atom is involved in the metallic bond, the single 3s electron. In magnesium, both of its outer electrons are involved, and in aluminum all three are involved.

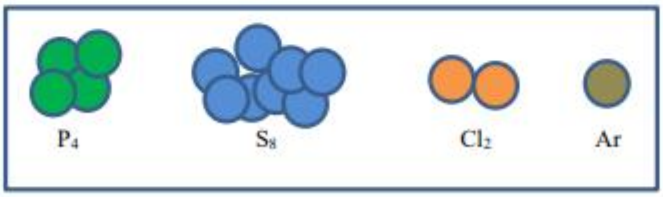
Silicon is a metalloid; it has a giant three-dimensional structure in which the Si atoms are held together very strongly. Starting with phosphorus, the elements exist in simple, discrete molecular units



(A)

(B)

Jim Clark



(C)

Figure 5. Delocalized electrons in sodium atom (A), network covalent structure (B), and simple molecular structures (C).

Melting Point

Trend: Generally increases from sodium to silicon, then decreases going to argon with a "jump" at sulfur.

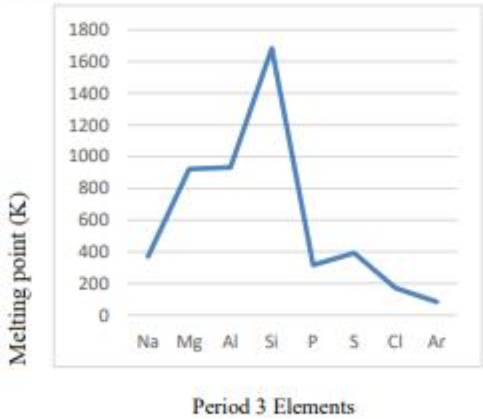


Figure 6. Graph of melting point of period 3 elements.

Explanation: Metal elements have metallic bonding, in which positive metal ions are attracted to delocalized electrons. From sodium to aluminium, the charge on the metal ions increases from +1 to +3, the number of delocalized electrons increases. Hence, the melting point increases because the strength of the metallic bonding increases.

The very high melting point of silicon is caused by the arrangement of its atoms, in which an atom is covalently bonded to four other silicon atoms and, this extends in three dimensions to form a giant macromolecule.

The remaining elements of period 3 have low melting points because these elements require little energy to break the van der Waals' forces between the molecules. The strength of the van der Waals' forces decreases as the size of the molecule decreases. Phosphorus exists as P_4 molecules, sulfur exists as S_8 molecules, chlorine exists as Cl_2 molecules, and argon exists as individual Ar atoms (Figure 5).

Electrical Conductivity

Trend: Increases from sodium to aluminium, then decreases sharply to silicon.

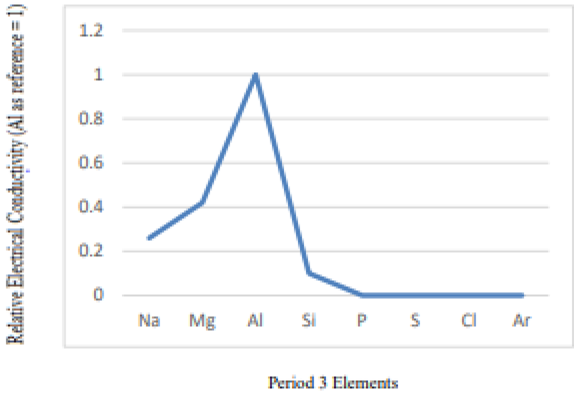


Figure 7: Graph of electrical conductivity of period 3 elements

Explanation: The number of delocalized electrons increases from sodium to aluminum, thus there are more electrons which can move and carry charge so the electrical conductivity increases.

Silicon is a semiconductor because it requires higher temperature to delocalize the electrons. There will be a separate discussion about semiconductors in the next Learning Guide.

The outer electrons in phosphorus, sulfur and chlorine are held strongly in covalent bonds so they are not free to move and carry charge. In argon (monoatomic) the outer electrons are held strongly in a stable third energy level so they not also free to move and carry charge. Hence, their electrical conductivity is zero.

Navigate	**NON-GRADED FORMATIVE ASSESSMENT** 1. Classify the structures of period 3 elements as metallic, simple molecular, or giant molecular. 2. Which is larger Mg^{2+} or Al^{3+}? Explain your answer. 3. Arrange the following period 3 elements in order of increasing electrical conductivity. S, Mg, Si, Al, Na **GRADED FORMATIVE ASSESSMENT** 1. First ionization energy generally increases across period 3 elements. Use electronic structure in explaining why it drops at sulfur.(*3pts*) 2. Arrange the non metal elements of period 3 in order of decreasing melting point.(*1pt*) 3. Given the property, which elements are arranged in increasing order? (*3pts*) A. Atomic Radius: Cl, Al, Si, Mg B. Ionic radius: Al^{3+}, Mg^{2+}, Na^{+}, S^{2-} C. First ionization energy: Si, S, P,Cl D. Melting Point: Mg, Al, Si, P E. Electrical Conductivity: P, Si, Mg, Al	11 min	

Knot 	Atomic radius decreases across period 3 elements while first ionization energy generally increases with a " drop" at aluminum and sulfur. Anion is larger in radius than its atom while cation is smaller than its atom. The electronic and molecular structures of the elements affect the melting point and electrical conductivity.	0.5 min	

[a] suggested time allocation set by the teacher
[b] actual time spent by the student (for information purposes only)

Answer Key:
NON-GRADED FORMATIVE ASSESSMENT

1. metallic: sodium, magnesium, aluminium
   simple molecular: phosphorus, sulfur, chlorine, argon
   giant molecular: silicon

2. Mg^{2+} is larger than Al^{3+}. Mg^{2+} and Al^{3+} have the same number of electrons however Al^{3+} has one more proton. Thus, the electron cloud in Al^{3+} is pulled inward more than that in Mg^{2+}.

3. S, Si, Na,Mg, Al

References:

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Clark,(2019). *Metallic bonding*. Retrieved from: https://www.chemguide.co.uk/atoms/bonding/metallic.html

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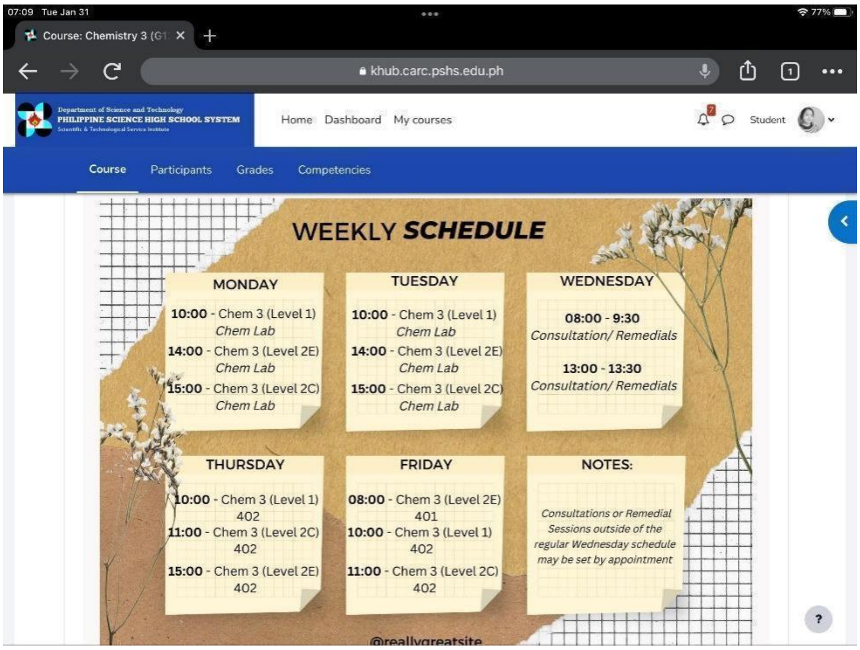
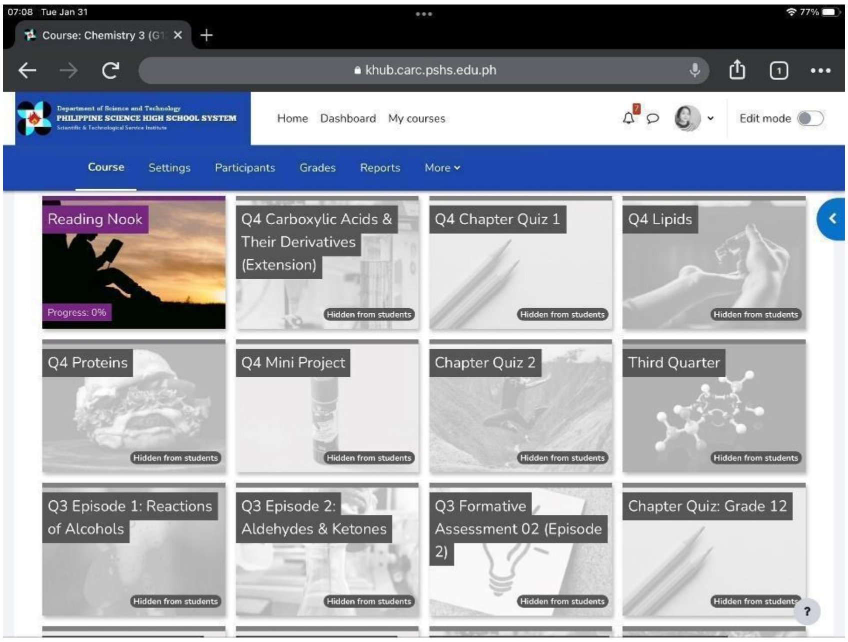
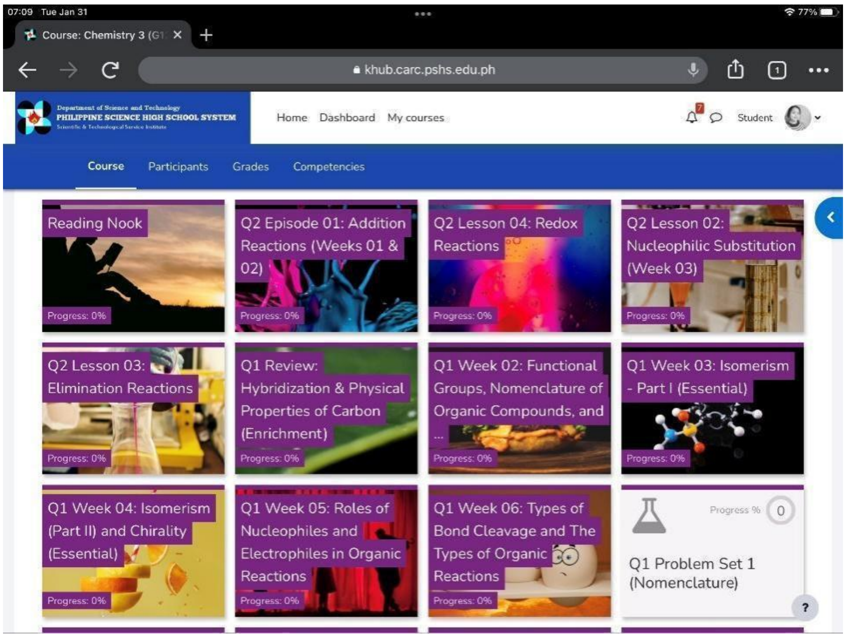
APPENDIX Q

Sample Screenshots of the KHub online learning management system






07:09 Tue Jan 31
Course: Chemistry 3 (G
khub.carc.pshs.edu.ph
PHILIPPINE SCIENCE HIGH SCHOOL SYSTEM
Home
Dashboard
My courses
Student
Course
Participants
Grades
Competencies
Reading Nook
Progress: 0%
Q2 Episode 01: Addition Reactions (Weeks 01 & 02)
Progress: 0%
Q2 Lesson 04: Redox Reactions
Progress: 0%
Q2 Lesson 02: Nucleophilic Substitution (Week 03)
Progress: 0%
Q2 Lesson 03: Elimination Reactions
Progress: 0%
Q1 Review: Hybridization & Physical Properties of Carbon (Enrichment)
Progress: 0%
Q1 Week 02: Functional Groups, Nomenclature of Organic Compounds, and ...
Progress: 0%
Q1 Week 03: Isomerism - Part I (Essential)
Progress: 0%
Q1 Week 04: Isomerism (Part II) and Chirality (Essential)
Progress: 0%
Q1 Week 05: Roles of Nucleophiles and Electrophiles in Organic Reactions
Progress: 0%
Q1 Week 06: Types of Bond Cleavage and The Types of Organic Reactions
Progress: 0%
Progress %
0
Q1 Problem Set 1 (Nomenclature)

APPENDIX R

QUALITATIVE DISCUSSION ON THE SLS RESULTS OF SURVEY

The survey questionnaires included asking the students which indicators (for each determinant) positively and negatively influenced their learning satisfaction. This section analyzes the influence of LG and Khub as well as Teacher related indicators on student learning satisfaction.

1. LG as determinant of SLS

A. Which of the learning guide indicators positively affects your learning satisfaction the most? Why?

Grade 9: The grade 9 students indicated clarity of the instructions in the LG, completeness of the LG, and creativity are the indicators that positively affected the student's learning satisfaction. In terms of clarity, the common comments of the students are “the modules are easy to read,” “easy to understand,” and “easy to follow.” A couple of students pointed out that clarity positively affects their learning satisfaction because “it is important to understand the subject and learning guide associated with it to produce great scores”. This answer validates the SLS model where the SLS and academic performance are related indirectly through the LG.

The students also find the LG modules with illustrations, visual presentations, and online links as signs of creativity. Finally, the students find the LG modules complete, meaning all they need for the lesson are included in the LG material.

Grade 10: The grade 10 students also indicated clarity and completeness as the main indicators that positively affect their learning experience. Most grade 10 students find clarity and completeness of the LG as closely connected to their learning and understanding of the Chemistry lessons. The students find both the clarity of the LG directions and instructions and the completeness of information they need to be important to “understand the lessons or topics” and “to help them learn the lessons.”

The students also find their LG materials to be complete with their needed resources to study. They also find their LG modules to be of a high level of clarity (instructions and discussions are clear as they read through the material).

Grade 11: Aside from clarity and completeness, the grade 11 students find the modularity of the LG as the main indicator that positively affects their learning satisfaction. The students appreciate the LG when the discussions are short but clear in directions and complete. They want the modules to be “short but very informative,” “do not take up much time to study,” and “small and can be read in a short time.”

Grade 12: Aside from clarity and modularity, the grade 12 students find completeness of the LG as an important indicator of their learning satisfaction. The most common reason for this is the students find it “easy and less time consuming [to use the LG] rather than seek other sources” for studying the Chemistry lessons.

ALL grade levels agree that clarity of the directions in the LG is most important. Next in importance is the completeness of the LG followed by creativity.

B. Which of the learning guide indicators negatively affects your learning satisfaction the most? Why?

Grade 9: Time allotment negatively affects Grade 9 learning satisfaction. While the students want their LG to be complete, they do not appear to appreciate activities that take most of their time to study and solve problems. They find some discussions to be “lengthy,” and “wordy” and take too much time to read.

Grade 10: Like the Grade 9 students, the Grade 10 students also complain that some modules take them too long to read and study due to lengthy discussions. They complain of the modules being wordy/text-heavy and hard to digest during their study time. In addition to this, they also complain about the quantity of information or lessons in the LG. Most complain that they are overwhelmed by the amount or number of learning guides being given to them.

Grade 11: The Grade 11 students find time allotment to do the LG activities and quantity of LGs as the indicators that negatively affect their learning satisfaction. Like the Grade 9 and 10 students, the Grade 11 students also complain about too many modules in the LG (“too many modules to read and too little time”).

Grade 12: Students complain about the LG completeness, that some of the information they need is not in the modules and they need to Google some information on the lesson. They also complain about the time allotment for doing the LGs. Some students complain that the 30 minutes designed to read one LG actually took them 3 hours to read and study.

2. KHub as determinant of SLS

A. Which of the KHub indicators positively affect your learning satisfaction the most? Why?

All grade-level students find the KHub easily accessible (if you have a fast internet connection), easy to use, and easy to navigate. Furthermore, a lot of the students noted that the best feature of the KHub is its notification feature of recording the history (calendar feature) of the student KHub activities done and activities that need to be done.

B. Which of the KHub indicators negatively affect your learning satisfaction the most? Why?

The complaints of all grade levels using the KHub are almost the same: "the response time is too slow" and "notifications come late or no notification is given at all." Other times, some students complain that notifications flood them. The students also complain that the KHub sometimes is slow to load. There might be a problem with the internet connectivity of KHub. In this digital age where students expect fast connectivity and fast speed of data transfers, these problems encountered by the students must be fixed as it becomes a source of students' dissatisfaction and distaste of the KHub.

3. The Teacher as determinant of SLS

The students were asked the questions, "Which of the teacher factor indicators positively affects your learning satisfaction the most? Why?"

For the Grade 9 Chemistry students, the teacher's mastery of the subject gives the students the main reason for their learning satisfaction, especially when the teacher exudes enthusiasm over his/her teaching and shows the enthusiasm that he/she wants the students to learn. In addition to mastery of the subject, the students also indicated that good communication skills are important for them to be satisfied in learning. A teacher who explains the lesson well gives clear directions and expectations and puts effort to help them understand the lesson well, giving the Grade 9 Chemistry learner satisfaction with their teacher and on learning. Finally, the Grade 9 students also indicated that when the teacher is considerate (not strict), especially on deadlines of requirements, they are more motivated to learn. Due to the expectation of upholding the high standard of PSHS education, teachers are very strict on deadlines of assigned academic requirements. Students complain of unreasonable time to complete the requirement and submit them on time. When students are not able to meet the deadline, it causes stress knowing they will have a lower score and thus a lower grade. Teachers who are considerate (listening to their reason for not being able to submit on time and extending deadlines) puts the teacher in a positive light. The teacher must be careful to balance being considerate and being firm on deadlines because this affects students' interest to learn and eventually their satisfaction.

For the Grade 10 Chemistry students, being considerate and understanding of deadlines and lowering their high expectations of the students on learning the lessons is the number one factor that gives the Grade 10 students satisfaction in their learning. Communication in class, especially in explaining the lessons well, is the next important factor that leads to learning satisfaction for Grade 10 students.

For the Grade 11 students, almost half of the respondents indicated that the consideration and understanding of the teacher on deadlines of submission of requirements positively affect their learning satisfaction.

The Grade 12 students find communication more important than the teacher's mastery of the subject. Being on the path of independent learners as they progress to the college/university level learning when they graduate, the grade 12 students felt that they need all instructions and expectations to be clear to them. The teacher's mastery at this grade level is a taken – The teacher MUST know and be an expert on what he/she is teaching. PSHS only assigns teachers who are experts in their field. Also, Grade 12 students appreciate teachers who are considerate and lenient (who give extensions) on the submission of course requirements.

The respondents were also asked the counter negative, "Which of the teacher factor indicators negatively affects your learning satisfaction the most? Why?"

For the Grade 9 students, the failure of the teacher in returning outputs and feedback on time lead negatively affects Grade 9 learning satisfaction. The students expect the teacher to return their checked assignments/quizzes before their scheduled exam so they can use them to review. The students also expect the teacher to respond to their queries as soon as possible. Because of the online setting, students who are studying their lessons may message their teacher on a lesson or point they do not understand or unclear directions, else the students cannot proceed with learning the next lesson. It will cause stress to the students if it takes the teacher too long to answer and especially if the teacher does not respond at all.

For the Grade 10 students, students complain about the way the teacher teaches the subject. The students find the pacing fast, lessons not clearly taught and explained, and may not know what the teacher is teaching at times. Another complaint is the timeliness of returning outputs and feedback to the students. Punctuality is also a complaint.

For the Grade 11 students, they agree that timeliness in returning outputs and feedback also negatively affects Grade 11 learning satisfaction. The student's complaint is that outputs and feedback are returned at the end of the quarter or after the grades are computed.

More than half of the Grade 12 students did not give a reply. This might indicate that either there is none of the teacher factors that negatively affected their learning satisfaction or they don't care at all. Those who responded gave varied answers.

4. Assessment as determinant of SLS

For the assessment survey, the students were asked the question, "Which of the assessment factor indicators positively affects your learning satisfaction the most? Why?"

For the Grade 9 students, they noted that the duration of assessments or length of time allotted for assessment is reasonable, and multiple-choice type assessment is preferred. The number of assessments is also reasonable for them.

For the Grade 10 students, the students agree that they are also given ample time to complete and submit their assessment activities. Giving clear instructions on the directions of assessments is also important to them. Finally, the level of difficulty is good enough for them to be engaged in the assessment activity and learn.

For the Grade 11 students, the duration of deadlines is found to be reasonable by some of the students. They also noted the level of engagement

For the Grade 12 students, in relation to the duration of deadlines, the students appreciated that the teacher is flexible on deadlines and also extends submission deadlines. The format of activities is fun and helpful in understanding the lesson. The discussion on the applications of the lesson is also seen as important in the level of engagement.

On the question, “Which of the assessment factor indicators negatively affects your learning satisfaction the most? Why?”

For the Grade 9 students, the students complain of the level of difficulty of assessment as very hard or very difficult. They also complain about the number of assessment activities and the longer time needed to complete them leading them to not be able to complete them to be submitted on time or set deadlines.

For the Grade 10 students, the students complain of some unclear instructions on their assessment activities. While some students are appreciative that the teacher extends deadlines, there may have been instances that the deadlines were not extended and that they complain of lengthy (time-consuming) assessment activities as a reason they are not able to beat the deadline. They also complain of unclear instructions on their assessment activities.

For the Grade 11 students, the main complaint is the number of required assessment activities in extreme cases. Some students complain of too few assessment activities at the start of the school year and it affects their grades because one low score in an assessment will definitely also lower their grade. On the other hand, a large number of assessments that were given at the end of the school year caused the students to be “overwhelmed.”

For the Grade 12 students, the complaint is on the format/choice of assessment outputs such as PowerPoint presentations, infographics, and creative outputs instead of the usual academic assessment such as quizzes or exams.