FACEBOOK AS A LEARNING SUPPORT TOOL FOR PHYSICAL SCIENCE GRADE 12 LEARNERS IN SELECTED SCHOOL IN THE OSHIKOTO REGION, NAMIBIA

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ABSTRACT

The purpose of the study was to explore whether Facebook has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level in selected schools in the Oshikoto Region. The hypothesis of this study was:

H_0: There is no significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

H_1: There is a significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

The study used a quantitative approach with a quasi-experimental design, constituted of a Non- Equivalent-Groups Pre-test, Intervention and Post-test. The sample consisting of 38 participants were selected using stratified random sampling method in order to ensure that not all students of the same academic ability are in the same group. Both the control and experimental group consisted of 19 participants in each group.

During the intervention, the control group participants were supported in a traditional way of teaching. They received notes, handouts, exercises and homework. While for the experimental group, in addition to the traditional way of teaching, had access to multimedia and interaction through Facebook.

After the intervention the mean score of the experimental group highly increased exceeding the mean score of the control group. The calculated statistical value (t-value = 4.5802363101) at $\alpha = 0.05$ with a degree of freedom of 36 is greater than the critical statistical value (t - critical =2.750). Therefore, there exists a significant difference between the control and experimental score marks when Facebook was used as a learning support tools. These reject the null hypothesis and accept the alternative hypothesis. This study shows that teachers can no longer avoid using relevant social media technologies. Therefore, the study put forward a case that there is a need to develop models and strategies to guide all educational stakeholders on how Social Media Networks can be effectively used as learning environments.

TABLE OF CONTENT

CONTENTS **PAGE**

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

DNEA: Directorate of National Examinations and Assessment

MoEAC: Ministry of Education Art and culture

NIED: National Institute for Educational Development

NSSCO: Namibia Senior Secondary Certificate Ordinary Level

SNS: Social Network Sites

UNAM: University of Namibia

UNESCO: United Nations Educational, Scientific and Cultural Organization

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I would further like to thank my mother Ignatius Edita and my late father Norbert Amunime for the good upbringing and for teaching me not to give up no matter how hard the situation may be. Thank you to my siblings and my wife Justina Peneyambeko Amweero for the words of encouragement, financial assistance, and for being with me throughout the struggle. Lastly, I would love to thank my friend Setson Tangeni Abisai for the support and information sharing that accelerated the completion of this study.

DEDICATION

I dedicate this thesis to my wife Justina Peneyambeko Amweero, my son Leonard Haufiku Amunime and my daughter Simaneka Tuyenikelago Faith Amunime. This thesis will be their educational motivation so they will always take education seriously.

DECLARATION

I, Leonard Amunime, hereby declare that this study **"Facebook as a learning support tool for NSSCO Physical Science grade 12 learners selected schools in the Oshikoto region"** is my own work and is a true reflection of my research, and that this work or any part thereof has not been submitted for a degree at any other institution.

Leonard Amutenya Amunime		Apnt 2022 ~~10 February 2022~~
Name of Student	**Signature**	**Date**

CHAPTER 1: INTRODUCTION

1.1 Background of the study

The past decade has shown a great increase in internet usage patterns worldwide, especially in the area of social media. Social media is defined as a group of internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content (Kaplan & Haenlein, 2010). Social media allows users to create online communities to share content that deals with various forms of media content such as pictures, videos, ideas, personal messages, and other sources of information (Kaplan & Haenlein, 2010). In Namibia, the use of social media increased various web-based interactions, such as maintaining contact for friends and relatives, allowing people to conduct business, learn new skills, and get updated with daily news (Peters, Winschiers-Theophilus & Mennecke, 2015). Among all the social media sites, Facebook has become the most commonly used application to support interpersonal interactions, communications, entertainment, and social bonding among its users (Jonson, 2014). Similarly, 80% of Namibian university students indicated Facebook as the social media of choice (Peters et al, 2015).

A belief that digital technology positively impacts teaching and learning and it has the potential to support education across the curriculum (Bamrara, 2020), has led to the Namibian government creating programs for ICT integration at schools. Furthermore, it is important for the Namibian educational systems to seek innovative learning methods that integrate the use of supportive technologies for the purpose of mastery of content, and development of critical thinking, communication, collaboration, and creativity (P21, 2016).

The Oshikoto Region in Namibia is a heterogeneous region that consists of 8 school circuits that comprise various secondary, combined, and primary schools. The Oshikoto Educational Region is a multicultural region with learners from different geographical locations, backgrounds, financial status, and levels of access to technology. Social media and technology are accessible in some schools in the region through the use of school computer labs or through the use of personal mobile devices. The Oshikoto region has shown slightly poor performance in stoichiometry as compared to other regions. Even though cell phones and personal devices are not permitted in Namibian schools, learners have access to them after school when they are at home or during holidays. It is against this background that this study aims to focus on using Facebook as a tool for 21st-century learning support to NSSCO Physical Science learners.

1.2 Statement of the problem

Stoichiometry is a branch of chemistry that deals with results of quantitative measurements (Espinosa, Rebecca & Marasigan, 2016) and qualitative relationship between the relative quantities of substances taking part in the chemical reaction (NIED, 2018). Stoichiometry is a complex concept, as it cut across sub-discipline of chemistry such as analytic chemistry, Physical chemistry, and organic chemistry (Hafsah, Rosnani, Zurida, Kamaruzaman & Yin, 2014). It involves calculations of the number of reactants and products (mole) using various logics and strategies, writing balanced chemical equations, writing empirical formulas, and drawing the structure of atoms and compounds (NIED, 2018).

Stoichiometry is perceived to be a difficult topic by most learners (Espinosa et al, 2016) since its concepts are interlinked and require learners to understand one concept to be able to solve problems related to the others (Sunyono, Yuanita, & Ibrahim,

2015). For example; solving stoichiometry calculation require students to master different aspects that serve as procedural steps leading to correct answers, such as mole concept, balancing chemical equation, algebraic procedure, and interpretation of word problems into mathematical equations (Hafsah et al, 2014).

Understanding chemistry is crucial and it can be achieved. However, it requires learners to perform a high level of mind processing (Sunyono et al, 2015). This means learners should be equipped fully to understand and apply principles involved in mole ratio and proportional calculations (Hafsah et al, 2014). To ensure these, teachers should use various teaching methods that will enable learners to be critical thinkers, and that will allow learners to be responsible for their own learning by developing metacognitive and critical thinking strategies (Espinosa et al, 2016). Therefore, it is extremely important for teaching and learning to take place using a variety of visualization models and interaction platforms.

Learning support assist in meeting learners' academic, social and emotional needs and creating a conducive environment that enhances learners' self-esteem, hence improve academic performance (Bojuwoye, Moletsane, Stofile, Moolla & Sylvester, 2014). To ensure the success of learners, education support services must be strengthened and placed at the centre of teaching and learning as a key strategy to address challenges to teaching and barrier to learning. These will involve ensuring learners exposure to learning resources, exploring and availing learning interaction platforms, offering remedial lessons/developmental courses, summer bridge programs, learning communities, academic counselling, tutoring services (Bettinger, Boatman & Long, 2013), and any other support that will improve the quality of teaching and learning and the effectiveness of educational activities. Like other learning support mediums such as learning groups, extra/remedial lessons, afternoon and evening studies, social

network sites are progressively gaining attention in relation to school practice and pedagogies (Manca & Ranieri, 2017). Social network sites eliminated the boundaries between online communication and offline communication (Allen, 2012). There exist various social network sites that allow interaction and can be used as a learning support environment and hence improve academic performance or learning outcomes. For example, WhatsApp, Facebook, Telegram, Twitter, Edmodo, etc. It is however the responsibility of teachers to identify the site that best fits their learners or that is observed to promote effective learning and provide a conducive and supportive learning environment. The features of the site and accessibility discriminate in the choice of which site will be preferred.

Though there exists numerous social media and network sites, this study focuses on Facebook as a learning support tool. This is because of the potential of the site to support students learning, peer networking (Vivian, 2011), and provide an opportunity for social and emotional support (Wang, Lin, Yu & Wu, 2013). Unlike other sites such as WhatsApp, Facebook has features that allow easy communication in groups and sharing various media and direct asynchronous or synchronous discuss on them (Vivian, 2011). Secondly, Facebook has a user-friendly interface that allows users to interact freely such that there is no training required even for new users. Facebook allows a wide range of networking with people that one may not know offline (Vivian, 2011). In addition, the shared content on Facebook is saved and remains online; hence such content does not affect the memory of the device used and is accessible anytime, from anywhere, and from any device for a very long time.

Facebook gained greater popularity with about 1.2 billion active mobile users (Facebook, 2015), and the number increased gradually to be 1.69 billion by 2020 (Facebook, 2020). In a recent study of Facebook used by Namibian youth, the

prevalence of Facebook usage was 80% with an average of 2.6 hours per day active time on Facebook (Peters et.al, 2015). It was found that 23% of Namibian youths' time was used for updating their Facebook status (Peters et.al, 2015). The Namibian youth perceived Facebook as more fun and less expensive than SMS/texting (Peters et.al, 2015). The education sector denoted interest toward Facebook as a learning and as an instructional tool (Manca & Ranieri, 2017). Facebook provides affordance for online communication, interaction, and networking allowing users to join virtual educational groups (Wanget al, 2013) widening the context of learning and sharing of learning resources (Manca & Ranieri, 2017).

Given the rationale indicated above, Facebook could be an inexpensive, accessible, and effective support tool to improve learners' academic performance, if it is used in an appropriate way. This study is therefore intended to explore how Facebook can be used effectively to support learning, enhance understanding and improve the academic performance of learners in Physical Science on the topic of stoichiometry.

1.3 Purpose of the study

The purpose of the study was to explore whether Facebook has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level in a selected school in the Oshikoto Region.

1.4 Hypothesis

The hypothesis of this study was:

H_0: There is no significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

H_1: There is a significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

1.5 Significance of the problem

The study will contribute to a better understanding of Facebook in creating a learning support environment for informal education to enhance better performance in Physical Science at senior secondary school in Oshikoto Region. The research results will provide evidence of teaching models in the use of Facebook that can be further developed for effective use at schools. Facebook allows interaction, improves communication, sharing of ideas, and working together online to achieve the common goal. Therefore, engaging learners on Facebook may improve the development of the 21st-century skills of collaboration, communication, critical thinking, and creativity within Namibian learners, which may boost learners' academic performance.

1.6 Limitations

The findings from this study cannot be generalized to the whole of Namibia. They will reveal the situation in the contexts investigated. Data is largely dependent on the co-operation of the Participants, namely learners, teachers, and school principals. Without their full participation, there will be no relevant data collected.

1.7 Delimitations

The participants in the study will be Grade 12 Physical Science learners and senior secondary school Physical Science teachers in the Oshikoto Region.

1.8 Definition of terms

Social Networking Sites: These are web applications or online communities and communication tool that enable users to create a public and semi-public profile within

a bounded system, articulate a list of other users with whom they share a connection, (Madhusudhan, 2012) and interact with other users using a variety of formats.

Technology integration: Is viewed as the use of computing devices such as desktop computers, laptops, handheld computers, software, or Internet in schools for instructional purposes (Bingimlas, 2009).

Social media: is defined as a group of internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content (Kaplan & Haenlein, 2010).

21st-century learning support: The learning tool that supports the delivery of the core competence such as collaboration, digital literacy, critical thinking, and problem solving that help students thrive in today's rapidly evolving, technological saturated world (*Partnership for 21st-century learning*, 2016).

Facebook: is a social network site, created in 2004 for Harvard university students by Mark Zuckerberg. The site allows users to sign up for a free profile that will enable them to connect, interact and share the various formats of media (Facebook, 2015).

1.9 Organisation of the Thesis

The thesis is made up of five chapters. Chapter 1 present an overview of the study, the background of the study, the research problem and provide the reader with a general working knowledge of the reason for choosing Facebook and the specific topic of Stoichiometry in Physic Science. The literature review in Chapter 2 summarizes the literature in the field and presents the framework that underpins this study. Chapter 3 presents the research methodology and study design necessary for the data collection and analysis procedures and also describes the study's sample and case profiles. Chapter 4 presents the results and findings of the study. Chapter 5 reports the analysis and conclusion of the findings, as well as possible recommendations of this study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter introduces the theoretical approach grounding this study and literature around the topic of using Facebook as a learning support tool. The particular focus is on the support systems for learning and specifically on how learners learn in social settings. In this area of the framework, the attention is on allowing equitable access to quality learning tools, technologies, and resources.

Grade 12 being the exit point in the academic achievement at basic education level, academic performance at this point greatly affects students' life as the grade 12 results determine whether the student is to proceed to institutions of higher learning to further his/her studies and or employment. There are many studies addressing the possible causes of low performance among grade 12 learners. However, only a few studies have focused on the possible solution to prevent low performance or to improve academic performance. This study is therefore aimed at assessing the impact that Facebook as a social interaction platform can have on the learning and teaching of physical science. The study is based on the assumption that: *There is a significant difference in the learner's academic performance in NSSCO physical science on the topic of stoichiometry when Facebook is used as a learning support tool.*

Due to an increase in online accredited courses and e-learning, the use of portable technology and mobile phone applications is perceived to play a major role in enhancing effective learning (Dunn, 2014). Scholars have different perceptions of the effects of social networks on the academic performance of learners. Some perceive that Facebook promotes social interaction but not academic engagement (Williams, 2011) while others view Facebook as a learning support tool that can improve social

interaction, enabling learners to learn in a social setting hence resulting in improved academic learning outcomes (Manca & Ranieri, 2016). The differences can be mitigated if proper guidelines on how to use Facebook in an academic context are provided. The expectation placed on the role of technology or mobile devices and social media in education is ascending gradually, hence their use among students and educators has been the topic of greater concern and discussion worldwide (Aydin, 2012).

This chapter reviews the literature on Facebook as a social media platform and as a learning support tool and attempts to discuss the findings of other studies focusing on the strategies to be employed on Facebook use to improve learners' academic performance. The primary objective of the review is to gain a broader understanding of the topic, which will enable the researcher to fill the gap between theory and practice. This chapter further intends to present what other researchers have found on the use of social networks in education

Moreover, the theoretical framework is presented in detail and discussed to ground the study as it pertains to learning support, 21st-century skills, social media, and mobile technology to enhance learning and Facebook in education respectively.

2.2 Theoretical framework

The common perception amongst education professionals is that schools must move beyond the focus of basic competencies to promoting understanding of academic content at a high level by integrating interdisciplinary themes into the curriculum (P21, 2016). The theoretical approach of this study is social learning theory. The social learning theory is a theory of learning process and social behaviour developed by Albert Brandura, the theory proposes that new behaviours can be acquired by

observing and imitating the behaviour of others who are believed to be knowledgeable and credible (Streule & Craig, 2016). This theory signifies a commitment to helping educational stakeholders to understand how students learn and hence best support students in developing skills needed and the change in behaviours required to succeed in institutions, career, and life (P21, 2016). Learning comes from directly experiencing the consequences of using the observed behaviours, skill or process of observing others and seeing the consequences of their behaviours. Below is a diagrammatic presentation of the Social Learning Theory.

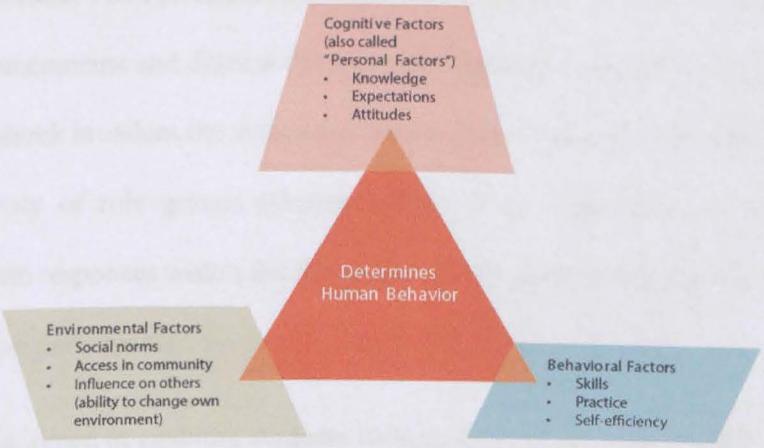

Figure 1: Social learning Theory (taken from https://sbccimplementationkits.org/quality-malaria-medicines/social-learning-theory/)

The Social learning theory (Figure 1) above describes learning as a cognitive process that takes place in a social context and can occur purely through observation or direct instruction. It further explains the variables that determine human behaviours and how they influence each other toward learning (Streule & Craig, 2016). The social learning theory further describes the mediation processes of learning: attention, retention reproduction, and reinforcement.

Unlike in traditional classrooms where the learners remain isolated from experts,

parents, and community, on Facebook knowledge is exchanged in an interactive, diverse complex community (Deaton, 2015). Facebook can be used as an interactive learning environment having diverse learners, educators and experts allowing students to communicate and get engaged in interaction with experts online, or in collaborative peer discussions. These actions will equip them with adequate knowledge and information and share insights on the topics (Siemens, 2014). Facebook allows teachers to post or share relevant information and learning materials such as syllabi, link to current news or articles for literature and lesson materials in form of video, PowerPoint slide, PDF, pictures, note clips, and animations at a faster rate as well as make announcements and discuss the materials shared or covered in class (Stephen, 2014). Facebook broadens the interaction area as it provides a platform for interaction with a variety of role groups (Deaton, 2015). Thus, behaviours of questioning, feedback, and responses within the Facebook environment reinforces the learning of the respective participants.

This study is aimed at enabling students to learn in relevant, real-world 21st-century contexts using technology-enabling environments and investigates equitable access to quality learning tools, technologies, and resources. In addition, the study created a platform for learners to learn from or influence others' behaviours through observation and interactions. The focus is on developing a strategy to enable Facebook to support learning.

2.3 Concepts of learning support

Learning support is the provision of resources and instructional strategies that give students physical, social, emotional, and intellectual support needed to learn or ensure academic progress. Learning support involves remedial or developmental courses, summer bridge programs, learning communities, academic counselling, and tutoring,

as well as student supports such as financial aid and child care (Bettinger, Boatman & Long, 2013). Schools today are characterized by high diversified student population (Lim, 2020). These students have diversified needs that require personalized support and assistance if they are to do better in school. Learning support play a major role in students learning, these include narrowing the gap between learners' academic performances, reducing low performance, re-engage learners in classroom learning, increase equity of opportunity of every student to succeed resulting in increased graduate rate and successful transmission to post-secondary opportunities (Adelman & Taylor, 2017). In addition, learning support ensures that all learners will make academic progress and achievement base on their individual potentials as it caters for the need of all learners considering their capabilities (NIED, Ministry of Education, 2014). Learner supports have long been marginalized in schools' improvement policies and practices (Adelman & Taylor, 2017). This is due to the limited school hours both the teachers and learners have and is mostly dedicated to the teaching and learning of subject content. Some schools opt to offer learner support after school hours.

2.3.1 Why is it important for schools or teachers to provide learner support?

Schools in the Oshikoto region are heterogeneous schools having learners that have social, financial, ethnic, and cultural diversity. Therefore, understanding how to provide appropriate learning paths for these diversified learners in the real world is essential (Li, Chiu & Tseng, 2019). Learners have different needs and abilities, and they undergo different challenges and difficulties such as low academic performance, lack/limited learning materials, lack of communication and innovative skills, financial and social barriers, and many more, which affect their life and academic setting (Lim, 2020). In addition, the current century demand changes in behaviours, workforce,

roles, and responsibilities in the society, and it conditioned the new generations to have instant access to information and engaging in real-time communication on a global scale (Arnold, 2018). Without proper learning support, learners will lack the ability to use their knowledge and will have limited skills on meeting life challenges as they are expected to master the set of the school curriculum (Tahir, Doelger & Hynes, 2019). Hence, they might feel frustrated which could significantly affect their academic outcome (Kuo, Chu & Huang, 2015). Therefore, there is a need for schools to develop students' leadership capabilities and skills that will allow learners to be effective in the workforce, and cope with or address socio-economic challenges and academic pressure (Arnold, 2018).

The education system should grand individual learners the opportunity to be exposed to and learn from multiple bodies of knowledge that enable them to acquire the necessary skills to perform a job and contribute to the workforce (Hendricks, 2016). It is significant for the school and teachers to have in place learning support strategies to better respond to learners' needs and improve the education system (Krie & amp; Livingston, 2019). For instance: motivation for learning, managing time for learning; tackling course materials; planning the learning; tackling the assignments; and dealing with failures and improved outcomes for children through regular communication of progress (Mulholland & O'Connor, 2016).

2.3.2 Technology orientated learning support

As millennials make way for Gen-Z students, incoming freshmen increasingly hold expectations of access to advanced software and communication resources (Arnold, 2018). The rapid development of information and communication technologies has provided numerous opportunities for teachers and students to promote participation, motivation, and personalized learning (Li, Chiu & Tseng, 2019). Many educators have

attempted to apply various computer-based instruction strategies to provide students with more efficient ways to learn (Kuo, Chu & Huang, 2015). These could significantly enhance students' learning skills, online learning engagement, and academic performance (Lin & Hsia, 2019). The convenience of the Internet has changed the traditional face-to-face collaborative learning and learning support approaches (Kuo, Chu & Huang, 2015). Support and Collaboration are now scheduled through Customized connections and self-sufficient communities (Arnold, 2018). Technology-orientated learning support system gives provisions of learning through learners communicating with embedded computers in the environment (Li, Chiu & Tseng, 2019), that is, students can cooperatively complete their learning tasks online or using computer software or the application of sharing platform for collaborative learning. These increase the effectiveness of team teaching and allow students to mutually create new knowledge (Kuo, Chu & Huang, 2015).

The role of technology has increased in daily life (Simsek & Yazar, 2019). Technologies inform the way people around the globe play, learn, communicate and work (López-Estrada, Rodríguez & Bonet, 2019). The global trend in the 21st century highlights the importance and necessity of technology use for students to demonstrate their learning process (López-Estrada et al, 2019). The development of information technology changed the education system (Simsek & Yazar, 2019) as it provides navigation of literacy sites that comprise of digitally and globally connected context, provision of digital tools and devices such as computers, laptop, printers, interactive whiteboard, smartphone, tablet (Jack & Higgins, 2019), and innovative and effective ways to connect more broadly with students and deliver content such as learning software to enhance teaching and learning or courses offered entirely online (Natow, Reddy & Grant, 2017).

Technological tools and resources positively influence the school and community environment and made learning meaningful when integrated with appropriate pedagogical methods (Simsek & Yazar, 2019). The use of Information Communication Technology provides an authentic learning context, expands learning through immersive and interactive technology, offering a web-based inquiry environment, and transforming students from consumer to creator of content (Yang & Baldwin, 2020). Technology provides extracurricular assistance to students through electronic methods such as synchronous and asynchronous online tutoring and 24-hour remote academic assistance via the internet (Natow et al, 2017). With the help of teaching and learning software learners' learning are tailored to individual learners need (Roden, 2011) and learners' academic performance is supported by providing individualized assistance with academic tasks or by monitoring students' academic behaviours such as attendance and performance (Natow et al, 2017).

The use of technology in school allow the provision of instructional content to students such as subject matters, announcement, online assignments and activities, online video lecture and open educational resources (Natow et al, 2017). These improve access to resources, learners' engagement, and opportunities for research and enable teachers to give timely feedback enhancing learning productivity and performance (López-Estrada et al, 2019). In addition, working with existing and emerging complex technological environment allow organization of course materials and to make them available to students through various online or offline platforms (Natow et al, 2017). Technological tools such as CDs, and online platforms such as Moodle, Edmodo, Facebook, Google classroom, Microsoft Teams etc. provide electronic storage and access to course material, students grade, and discussion board (Natow et al, 2017; Roden, 2011). These provide useful tools to deal with many of the

processes involved in activities, integrating and summarizing information, analysing and interpretation, and modelling information to develop a new idea.

2.3.3 The success of learner support on the learners' academic achievements

*1. **Improved performance through interaction***

Technologies allow students to interact and learn online and offline with their peers. Learning by sharing information and exchanging knowledge among peers could not only enhance the competitiveness of students, but could also improve their learning performance (Kuo, Chu & Huang, 2015). Web-based platforms allow for posed questions, discussion, and reflection between sessions (Waters, 2019). Grouping students for collaborative learning allows them to share their ideas and learning experiences, thus improve the learning performance of both the group and of the individuals (Kuo, Chu & Huang, 2015). Learners get a chance to assist each other with learning academic materials (Moore, 2018). Facilitated relationships among the group participants result in improved self-confidence, increased professionalism, and boost empowerment needed to persist within the academic field (Waters, 2019). Technology provides services that help improve learners' academic skills, such as writing, for example, online writing tutorials may help the learner to syntax and organise thoughts while gramma check service gives quick comprehensive feedback on language editing (Baccaria, Kerk & Huijser, 2019). Technology-orientated learning support tools combine test – teach – retest practice that optimizes individual performance through the assistance of assessment activities (Lin & Wang, 2017), enabling learners to self-regulate their learning by assessing their own work (Baccaria, Kerk & Huijser, 2019).

*2. **Enable teacher to understand individual learner's needs and uniqueness***

Technology-orientated learning support systems can provide personalized learning opportunities (Li, Chiu & Tseng, 2019) to help students achieve their goals effectively

such as standardized quizzes, online assignments, and discussion forums (Yang, Chen & Chen, 2018). It can also detect and record students' learning behaviours and status in real and virtual worlds (Li, Chiu & Tseng, 2019). Technology-orientated assessments will measure reputation, engagement, and destination outcomes (Arnold, 2018), enabling the teacher to analyse results, seek feedback and address problems within their teaching to improve individual student's learning (Waters, 2019).

The availability of learning software, enable teachers to assess the student's individual weaknesses and provide instruction and remedial assessments to help students master the required skills. The electronic assessment enables teachers to measure the learning process of the individual learner and the dynamic of the learner's cognitive ability, resulting in the teacher delivering the instructional intervention with personalized prompts (Lin & Wang, 2017).

3. ***Improved assessment and allow the provision of immediate feedback***

Assessment is among the most imperative elements of student life and significantly shapes their learning. The assessments are conducted with the purpose to evaluate what the student is learning and the skills acquired by the student (McKevitt, 2016). The e-assessment environment allows learners to interact with the assessment system directly and receive timely feedback (Lin & Wang, 2017), learners are able to receive immediate text-based or video-based solutions. The text-based solution presents detailed solutions while the video-based solution provides step-by-step guidance and teachers' explanations for the solution (Yang, Chen & Chen, 2018). By doing so learners are encouraged to participate in self-assessment to improve learning outcomes (Lin & Wang, 2017).

4. ***Enable teachers to monitor learning engagement***

With the availability of technology devices and application software, Teachers adopt more efficient learning support methodologies, as they apply technologies that assist with the performance of functions, operations, and communications (Arnold, 2018). Technology support smoothens the interaction between real-world and digital learning resources, learning supports practices, enhancement of effective learning activities (Li, Chiu & Tseng, 2019) and provide opportunities to practice assessments in no time (McKevitt, 2016). In addition, it allows the mining of data in new ways to produce valuable insights related to student needs and the effectiveness of programs (Arnold, 2018) to further understand the students' interaction patterns in the asynchronous discussion of the proposed collaborative learning platform (Kuo, Chu & Huang, 2015).

2.4. 21st century skills

2.4.1 Introduction to 21st century skills

The current century demands a set of different skills to function effectively at work, or as a citizen (Anoniadou & Claro, 2009). The global labour market is fitted with a variety of machines and digital technology devices that increase electronic interaction and boost personal engagement and efficiency (Jerald, 2009). This requires the education system to equip students with new skills and competencies, which will allow them to fit in the workforce and to actively contribute to economic development (Anoniadou & Claro, 2009).

The availability of technological tools is transforming the landscape of teaching and learning as it has an impact on how students learn and how they want to be taught (Black, 2010). As a result, the traditional curriculum is not enough (Jerald, 2009). The 21st century schools must prepare students to perform in today's workplaces. Therefore, teachers must stay current with the way students, families, and

communities use technology (UNESCO, 2011) and the differences between the teacher and learner generations must be recognised, analysed, and addressed to meet the needs of learners and of the digital workplace (Black, 2010). In addition, schools must provide students with a broader set of 21st century skills, to strive for a rapidly evolving technological saturated world (Jerald, 2009). The focus should be on what students can do with the knowledge they learned other than reproducing what they have learned in tests or in examinations (Silva, 2009).

2.4.2 What are the 21st century skills?

The 21st century skills are necessary skills required for students to succeed in their careers and personal lives (Jerald, 2009). These are skills people must possess in order to be effective workers or citizens in the knowledge society of the 21st century (Anoniadou & Claro, 2009). The 21st century skills comprise the ability to meet complex demand by drawing and mobilizing psychosocial resources (National Research Council, 2013) and the learning adoption required to succeed in the 21st century society. The 21st century skills are not new but form an integral part of learning (Silva, 2009).

To ensure academic success, students need to understand the major principles (core subject and arithmetic) and the skills to apply this knowledge to impact contemporary themes such as global awareness, finance, health, and environmental literacy. These skills are content knowledge, learning and innovation skills, information, media and technology skills, and life and career skill (P21, 2016). If we are to have a more equitable effective public education, skills that have been the province for a few must become universal (Rotherham & Willingham, 2010). Without the skills mentioned above, students will not be able to participate in the global economy. Therefore, schools must be more deliberate about teaching these skills (P21, 2016).

The 21st century skills are focused on the influence caused by the learning environment (P21, 2016). It is believed that the best learning is when students learn core subjects as well as skills of how to think critically to solve problems at the same time. It is for this scope that the 21st century skills put more emphasis on real-world learning, intrinsic motivation, competence & multiple pathways to expertise, as well as learning socially in groups and teams (p21, 2016). The 21st century skills did not replace basic and traditional knowledge and skills learned in content subjects, but they are aiming at equipping students on how to apply what they have learned in arithmetic and maths to deal with real-world challenges than replicating information during assessment (Jerald, 2009).

2.4.3 The 21st Century learning and innovative skills [The 4Cs]

These are set of skills learners need to adopt and improve in the modern work world (Trilling & Fadel, 2009) to become innovative, creative and work together to come up with the best solutions to problems (P21, 2016; www.21stcenturyskills.org). The interconnection of the global economy and political network require students to learn to communicate, collaborate, solve problems and initiate solutions or ideas (Saavedra & Opfer 2012).

1. Communication

Communication skills involve articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts (www.battelleforkids.org/networks/p21). A good communication skill is the ability of students to clearly articulate themselves through all media of communication (Mishra & Kereluik, 2011: p.21). These involve the sharing of thoughts, questions, ideas, and solutions among the students and the educators resulting in a student having a voice and a sense of responsibilities in the society (Anoniadou & Claro, 2009) and being

active and respectful listeners (Mishra & Kereluik, 2011) to decipher meaning, knowledge, value, attitude, and intentions. Good communication eliminates confusion in the academic setting and workplace which will make your students a valuable part of the organisation. Communication skills may involve criticizing, praising, defending the point, giving feedback, and presenting information or ideas (Anoniadou & Claro, 2009). It is crucial for students to learn how to effectively convey ideas among people with different personality types. Therefore, the teaching and learning environment must be prepared in such a way that it strengthens and increases the possibilities of communication. Students must be encouraged to be multilingual in order to communicate effectively in a diverse environment. Misha & Kereluik (2011) further indicate that students must have knowledge of the use of multimedia technologies and know-how to judge their effectiveness and assess the impacts multimedia technologies on improving communication.

2. Collaboration

Collaboration involves students working together exercising their talents, expertise, knowledge, achieve compromises and get the best possible results from solving complex problems to reach a common goal (www.21stcenturyskills.org). ICT improves information sharing and media literacy enabling students to work respectfully and effectively on their tasks in and out of the school (Mishra & Kereluik, 2011). This is done through the creation of a spontaneous learning environment (Anoniadou & Claro, 2009) of which individual efforts and contributions are recognised. Students must be prepared to work effectively and respectively in diverse teams sharing responsibilities, valuing individual contributions, being flexible and willing to sacrifice part of their own ideas & adopt others' to get the results for the organisation or group (Mishra & Kereluik, 2011).

3. Critical thinking

Critical thinking is the ability to critically analyse and evaluate information in order to form a judgment and make informed decisions to solve problems and challenges or the development of consciousness about the challenges in the 21st century considering social, cultural, and economic implications for individuals and society (Anoniadou & Claro, 2009). This involves the interpretation of information and making informed decisions based on the available information (Mishra & Kereluik, 2011). Students that think critically are able to look at a problem in a new way and link learning across subject areas.

4. Creativity and innovation

The ability of students to innovate and invent as well as to possess a will to try new approach to get things done is imperative for the 21st century. Creativity and innovation involve the application of a wide range of knowledge and skills to situations and evaluate the effectiveness of ideas and products (Mishra & Kereluik, 2011). Students who are creative in the 21st century, are empowered to see concepts in a different light, which leads to the initiation of new ideas, concepts and actions, hence they take ownership of their learning, being the developer of knowledge other than the consumer (www.21stcenturyskills.org).

2.4.3 Why are the 21st century skills important?

In current days and age, the pace of technological change is rapid (Jerald, 2009). The 21st century skills are the knowledge that can be applied in new situations to solve problems (National Research Council, 2013). These are skills needed to succeed in learning, work, and life. These skills are vital for everyone's success in the global competition. The 21st century skills enhance critical components for global economic success, such as globalization and ICT literacy.

Globalization means that more people from different places collaborate on more different kinds of work sharing a broad knowledge, i.e. the 21st century skills reduce the challenge of geographical distance as they allow collaboration across a wide range of distance (Jerald, 2009). For example, a business team composed of people from different continents that are highly skilled, having different experiences, diverse backgrounds and expertise may be more successful and competitive than a team composed of people from the same city who may have the same understanding, experience, and education level.

ICT literacy is the proficiency to effectively seek out, organise, and process information from a variety of media as well as the responsible use of media and technology (Mishra & Kereluik, 2011). Networked workers or students use the internet for email, WhatsApp, Facebook, or any other form of communication at home, work, or school (Jerald, 2009). These have a lot of advantages, for instance, people are able to share information faster result in them being up to date with daily news or current information and transport costs are reduced as people are able to use information technology to study or work from home.

2.5 Social Media

Social media is defined as a group of internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content (Kaplan & Haenlein, 2010). A web environment where the created content is aggregated, presented and shared (Hamid, Waycott, Kumia, Chang, 2015). Social media is a collection of websites and applications designed to build and enhance online communities (Asborne- Gowey, 2014). In an education context, social media can be a channel through which knowledge is transmitted between communities and schools (Al-Rahmi & Zeki, 2017). Some

examples of social media are Twitter, Facebook, WhatsApp, Instagram, YouTube, Wikis, Educational Software Board, etc (Asborne- Gowey, 2014, Al-Rahmi & Zeki, 2017; Ellison, Steinfield, & Lampe, 2007; Hamid, Waycott, Kumia, Chang, 2015).

Social media are made available in current time and widely used in the world today (Al-Rahmi, Othmsn & Yusuf, 2015) to create knowledge-sharing communities (Al-Rahmi, Othmsn & Yusuf, 2015) for networking and sharing of information (Asborne-Gowey, 2014) through chat and discussion forums (Blackenship, 2011). Social network communities and websites have noted an increasing trend of use recently by businesses, academic communities, and individuals (Al-Rahmi, Othmsn & Yusuf, 2015). In education, appropriate social technologies or online network sites can be used to facilitate a range of teaching and learning activities in a collaborative setting (Hamid, Waycott, Kumia, Chang, 2015).

2.5.1. The importance of using Social Network sites in education

Learners and youth are deeply immense in the use of Social Network sites (Thalluri & Penman, (2015). Hence Social Network sites have a tremendous potential for engaging learning in the curricular context (Schoper & Hill, 2017). Therefore, a growing number of organizations including colleges, universities, corporations, and secondary schools have commenced delivering training and education over the internet. SNS became an integral part of daily life, influencing the way humans connect, interact, and share all types of information (Stephen, 2014). Through the use of social media, people get to know each other, get updated with daily news, and share resources. In addition, social media connects students to society through interactive engagement in the social environment (Al-Rahmi & Zeki, 2017).

Social media plays a major role in education as it can be used to support learning and

teaching through online activities. The unique features of online network sites are that they allow content generating, interaction and collaboration, ease of use, functionality, and flexibility which have made social media flexible learning tools which are easy to adopt in education (Hamid, Waycott, Kumia, Chang, 2015).

Social media plays a positive role in enhancing and improving academic performance (Al- Rahmi & Zeki, 2017). As Hamid, Waycott, Kumia, Chang (2015) state, social media supports the constructivist approach of learning. Social media has a valuable role in facilitating the collaborative learning and engagement of students, teachers, and other education stakeholders in the learning process (Al-Rahmi, Othmsn & Yusuf, 2015). Social media are observed to improve learners' academic performance in various ways. Students socialise online and learn to a greater extent than in a traditional environment (Hamid, Waycott, Kumia, Chang, 2015).

It is further observed that social media guarantee access to materials in various formats as they have web-based technology that consists of rich text, sound, video, and image that make communication more interactive and pleasant (Norhailawati et al, 2019). Therefore, social media provide space for greater students' engagement and interaction (Blackenship, 2011; Al-Rahmi, Othmsn & Yusuf, 2015). Social media can be used to locate students' own content, opinions, and support across the network users (Hamid, Waycott, Kumia, Chang, 2015), this increase students' participation in learning activities (Al-Rahmi & Zeki, 2017) resulting in maximised students learning experience and knowledge (Al-Rahmi, Othmsn & Yusuf, 2015) as students are actively involved in their learning, taking control of their learning process and responsibility for their education (Blackenship, 2011). Students are able to manage and organise their own learning activities (Al-Rahmi & Zeki, 2017), share or publish their work and ideas in a public space for others to view, review and/or download

(Hamid, Waycott, Kumia, Chang, 2015). Social media further enables students to actively participate in discussions, upload their content, pose questions, leave a comment, raise their concerns, and ask for further explanations and clarity (Hamid, Waycott, Kumia, Chang, 2015).

Blackenship (2011) affirms that the use of social media boosts students' interests and motivation as they join in the interactive digital globe through which they explore the world (Blackenship, 2011). It further encourages students' information retention (Al-Rahmi, Othmsn & Yusuf, 2015). Social media allow easy publication, sharing, reuse of content and it supports links to relevant resources, thus students are constantly motivated to make use of it on a daily basis. Students can reduce their anxiety levels by using social media other than asking questions in front of their peers in class (Hamid, Waycott, Kumia, Chang, 2015).

Social media encourage collaboration as it provides the situation whereby a pair or a group of learners are constantly and effectively connect sharing ideas (Norhailawati et al, 2019) and engaged in the process of learning new knowledge, share knowledge among the group members, discuss their writing with peers and send and receive feedback before publishing (Al-Rahmi & Zeki, 2017). It allows them to work together on group tasks to share work, resources, and responsibilities (Al-Rahmi, Othmsn & Yusuf, 2015). Social Media are used by students to collaboratively learn how to solve problems with members on the group and to organise collaborative learning and study groups (Hamid, Waycott, Kumia & Chang, 2015).

Through collaboration, students extend their informal and formal interactions establishing active communication with their peers aiming to work toward a particular outcome (Hamid, Waycott, Kumia, Chang, 2015). Furthermore, social media

improves communication among students, students and educators, as well as students with professionals or experts in different areas (Al-Rahmi, Othmsn & Yusuf, 2015) enabling them to communicate with peers effectively, solve problems and organise events (Al-Rahmi & Zeki, 2017). These strengthen peer relationships and open communication (Al-Rahmi, Othmsn & Yusuf, 2015) resulting in students having a positive tendency to appreciate peers' work and support toward peer alumni and the creation of mutual support at school (Al-Rahmi & Zeki, 2017). Social media enable teachers to monitor learners' progress closely and provide timely feedback and guidance (Al-Rahmi, Othmsn & Yusuf, 2015). These will enhance a deeper understanding of the curricula (Al-Rahmi, Othmsn & Yusuf, 2015).

2.6. Mobile technology to enhance learning

Mobile learning is closely related to the mobility of technology, mobility of learners and mobility of learning It involves teaching and learning through the use of mobile digital devices (Sinen, 2015). Mobile technologies enable learners to access information anytime and from anywhere to perform authentic activities in the context of their learning (Martin & Ertzberger, 2013). Mobile learning has been increasingly used in the educational context in recent years (Sinen, 2015). For instance, students use their smartphones mostly for arranging meetings with their classmates and being commonly informed about courses (Economides & Grousopoulou 2010).

The use of portable technology and mobile phones application is perceived to play a major role in enhancing effective learning (Dunn, 2014). This is because they create a more interactive learning environment and foster collaborative studies between students, educators, and course materials (Dunn, 2014). Students see mobile devices as a great platform to carry out mobile learning applications such as Mindset-learn,

EverNote and other Open Education Resource sites which enable students to access educational information through their mobile phones freely (Raj Kumar, Iyengar & Ji, 2014).

Mobile technologies such as pen tablets, laptops, mobile phones, and wireless LAN connection, combined with software to support learning actions such as Google-classroom, Plinkers, Socrative, Microsoft Office, and others are not time or place bonded. Mobile technologies extend learning beyond the classroom and support collaborative and personalized learning, and improve interactions (Sinen, 2015). In addition, mobile technologies are considered the most important platform to access exam results, exams' timetables, and previous exams (Economides & Grousopoulou 2010).

2.7 Facebook as a learning support tool

2.7.1. Background

Facebook is a social network website originally designed in 2004 for college students in the United State before it expanded to the general public (Hew, 2011). Facebook enables users to interact and to collaborate within a predefined Virtual community by allowing them to construct a public or a private Profile with personal information such as an address, contact detail, interest, relationship status, etc (Grosseck, Bran & Tiru, 2011) in order to connect, communicate and interact with people who are part of their extended social network (Irwin, Ball, Desbrow, & Leveritt, 2012).

Facebook allows the designation of users to others as friends and allow users to send private messages, join groups, tag pictures, and share each other's contents (Grosseck, Bran & Tiru, 2011). Facebook is among the best and most used social networking sites globally with over a billion registered accounts (Facebook, 2016;

https://makeawebsitehub.com/social-media- sites/). Facebook is a multilingual platform supporting a broad variety of languages (Nadkarni & Hofmann, 2012).

2.7.2. Why is Facebook so popular with African youth?

In Africa, Facebook is a popular social networking site (Wang, Woo, Quek, Yang, & Liu, 2012). Youth use Facebook for different reasons, for example; to communicate and connect with friends, for marketing, work, social enrichment, and entertainment, or as a space for information sharing and updates through video, notes, pictures and get notification of parties, events, and social functions (Christy, Cheung, Chiu, & Lee, 2011). Among other social networks, the majority of the youths choose to use Facebook instead. This is because Facebook is affordable (Wang, et.al, 2012), people can access Facebook either on the Web or through mobile devices using wireless networks or little data. In Namibia Facebook uses cheaper data, the internet provider of Namibia MTC sells data for social media at a lower cost than the price for general data for internet use.

Facebook has built-in features that facilitate interaction (Nadkarni & Hofmann, 2012). These include a friends list, the wall, pokes, status, events, photos, video, messages, chat, groups and reaction. The *friends list* is a crucial component of Facebook, because it allows the end-user to create a public display of links to their connections which viewers can in turn click through to traverse the network. The *wall* is a term given to the Facebook feature that functions as a bulletin board and allows other users to post personal messages directed toward the end-user. The *pokes* feature allows users to offer initial greetings to other users. *Status* allows users to inform their friends of their whereabouts and actions. The *events* feature enables users to plan meetings or events that they can extend invitations for. *Photos* and *videos* allow users to upload albums, photos, and videos that other users can view and comment on. Communication with

friends is accomplished through *messages*, which are private or public, but also through a *chat* feature. The *groups* feature allows users to create and join interest groups that can be open or closed as designed to serve its academic, social, or business-related purpose.

In addition, Facebook is used to aid the studies and research, to connect educators with other professionals, and also for personal use (Dunn, 2014). Facebook is a platform that can be used by people to interact, share, access, and analyse information (Aydin, 2012). Furthermore, Facebook allows its users to construct, install and use third-party applications such as games, polls, and quizzes that may improve one's level of understanding or academic knowledge (Grosseck, Bran & Tiru, 2011).

2.7.3. The use of Facebook in education

Facebook has the potential to be used as an educational application that can promote achievement in education and improve academic outcomes. Facebook became a significant part of students' life. It is a valuable platform to support educational collaboration, communication, and information sharing if used effectively and in the right way (Aydin, 2012). The use of Facebook strengthened by the fact that Facebook allows students to actively engage in positively related communicative activities (Junco, 2012). Facebook creates a culture in which youth participate in creating and sharing content (Phillips, Baird, & Fogg, 2011), for example, online subject content discussion that may improve their performance and understanding. Facebook also empowers the e-learning environment by facilitating collaborative learning and students working together irrespective of the location and time (Christy, et.al, 2011). Facebook is considered to be a powerful tool that interlinks educators, students, and parents by providing a platform for them to effectively present their ideas and discuss various topics of concern (Phillips, et.al, 2011).

Educators do not only teach students subject content but also prepare students how to be responsible citizens of the nation in the future, hence apart from improving academic performance Facebook can be a tool to develop cognitive, psychosocial, morals, and ethics among students (Junco, 2012). In addition, learners spend much time in an informal learning environment interacting with peers and receiving content more than they do with teachers in traditional classrooms (Phillips et al, 2011). Facebook offers an environment that helps engage students and enriches the quality of student's experience as well as supports their academic & social goals through interactive learner's activities (Irwin, et.al, 2012). In addition, Facebook can help with Learning Management System (LMS-Facebook group) as teachers can easily create new courses and enrol students. LMS has a lot of benefits as it shifts the focus from content-based learning to process–based learning. Facebook facilitates the change from passive to active learning, it further promotes interaction between students and faculty members (Wang et.al, 2012).

2.7.4. The support of Facebook in education

Facebook impacts all levels of academia and academic settings (Aydin, 2012). The use of Facebook meets the needs of digital natives and digital learning styles (Phillips, Baird & Fogg, 2011). This is because it allows students to create their own content through interaction and to express their identity and creativity. Facebook improves reading habits and texting frequency among the learners (Aydin, 2012) and it demolishes the communication barriers between educators, between educators and students as well as between learners and their peers (Aydin, 2012). Dunn (2014) further states that Facebook boosts learners' motivation, connectivity, and engagement with materials that accelerate information sharing. It also equips students with the 21st century skills that enable them to suit in the digital community (Dunn,

2014), as it gives the students the freedom to use it in any way that best suits their individual learning style (Phillips, et.al, 2011).

Contemporary teaching has been adapted to include social media (Thalluri & Penman, 2015), hence institutions and educators are expected to catch up with social media application usage (Doğan & Gülbahar, 2018). This is due to the observed positive contribution brought by social media toward academic outcomes. For example, literature shows that, when social media such as Facebook are incorporated in education, they maximize collaboration and interactivity which in turn lead to improved academic outcomes (Thalluri & Penman, 2015). Secondly, Facebook improves communication that positively impacts engagement in teaching and learning (Stephen, 2014). Furthermore, Facebook and other social media allow content creation, frequent sharing of information, and have a positive impact on the learners' study activities such as conducting research, discussion in groups, and completing projects (Norhailawati et al, 2019). However, faculties, teachers, and learners are still unsure of how best to make use of Facebook to yield the best results (Schoper & Hill, 2017). Despite the known contribution and learning support Facebook provides toward continued learning and positive engagement (Thalluri & Penman, 2015), educators lack frameworks for ways in which Facebook and other social media can be used to improve learning performance (Schoper & Hill, 2017).

2.7.5 The challenges that arise with the use of Facebook and possible solutions

Even though Facebook is perceived to positively contribute to the education system, it comes along with several challenges and threats. For instance; society and educational stakeholders are threatened by the negativity associated with the educator use of Facebook and credibility such as the privacy of both the learners and educators (Junco, 2012) and the type of friendship between educators and learners on Facebook

(Aydin, 2012). Facebook may distract the purpose of teaching and learning if it is not used in a correct and appropriate way, as it only provides superficial contact with peers or teaching staff while detracting essential skills such as formal academic writing, verbal communication, and awareness of learning experience which should be developed in higher education (Dunn, 2014). Students may also encounter inappropriate content that may mislead them, confuse them, distract their learning or they may fall prey to online predators (Phillips, et.al, 2011). Dunn (2014) Further emphasizes that there is a high level of misunderstanding, miscommunication, misinformation and misbehaviours on Facebook as face-to-face does not apply on social media; this makes it difficult for teachers to explain concepts in detail.

2.7.6 Where do learners access their Facebook accounts mostly and why?

Based on personal information, experience and informal discussion with participant learners, the researcher found out that learners mostly access or check their Facebook accounts on their smartphones when at home. Learners hardly access their Facebook accounts while at school because phones are prohibited in schools and available school laptops or computers cannot be used to log into Facebook due to: either the school disable Facebook website in the school computers or it is a clear rule that learners should not by any way use school devices to log in to Facebook or other social media sites.

2.7 Summary

The educational demands of this new century require a new way of thinking, teaching, and learning. In addition, learning support and learning environment play a greater role in how the learners learn in the new century. Schools need to be reconfigured to emphasize high-order cognitive processes such as 4Cs (Mishra & Kereluik, 2011). The theoretical approach of this study is the Social learning theory. The 21st century

framework signifies a commitment to helping educational stakeholders to understand how best to support students in developing skills needed to succeed in institutions, career, and life (P21, 2016). Even though there exist good theories and Social Networks create platforms that ensure the attainment of 21st century skills, there is still a gap between theory and practice. For instance; there are no developed models with detailed strategies to guide teachers, learners, and educational stakeholders on how Facebook and other Social Networks can be effectively used as learning environments.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will present the methods used during the study. It will also discuss the research design, population & sample of the study, as well as the instrument administered and the analysis process followed to test the hypothesis:

H_0: There is no significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

H_1: There is a significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

3.2 Research design

The study uses a quantitative approach with a quasi-experimental design, constituted of a Non- Equivalent-Groups Pre-test, Intervention, and Post-test design to gain insight into the impact of Facebook as a learning support tool on the performance of learners in Physical Science on the topic of stoichiometry.

3.3 Population of the study

The population of the study was all the 16 Senior Secondary Schools in the Oshikoto region offering Physical Science.

3.4 Sample and Sampling procedure

The sample was selected using a stratified random sampling method in order to ensure that not all students of the same academic ability are in the same group. The intervention group consists of 19 learners and 19 learners were used as a control group while the remaining did not take part in the study. These 38 learners represented grade 12 Physical Science learners at the selected school.

3.5 Instruments

A pre-test post-test (Appendix F) tool was used to obtain data from the sample. The intervention consisted of a Facebook group on which the support materials such as video, pictures, PowerPoint slides, and links to access additional information on the topic were uploaded and where a discussion took place. The control group received printed notes and PowerPoint presentations, worksheets, and exercises on the topic, which are the traditional support mechanisms usually provided by teachers (See Appendix G).

3.6 Data collection procedure

The researcher visited the participating school at the beginning of the study to set up the study conditions and to brief the teacher participant as to what is the purpose of the study in order to ensure the validity of the data collected. The researcher explained to the participating learners their role, the significance of their active participation, and honesty in the study. The participating learners were divided into two groups: the control group and the experimental group. During normal class time, all learners received the same presentation, the same notes, and the same oral and written activities based on the specific learning objectives as stipulated in the syllabus. The researcher created a closed group on Facebook and added the participant learners of the experimental group. The researcher further uploaded the instructions which explained the primary purpose of creating the group, the expectations from the group members, and a brief logic to be followed.

3.6.1 Pre research questionnaire

The researcher conducted a pre-research questionnaire (Appendix E) aiming at acquiring the participants' demographic information. The students were asked to indicate their age, gender, and the device through which they access Facebook.

3.6.2 Pre-test

All the learners who participated in the study wrote the same pre-test on the topic of stoichiometry at the same time, irrespective of whether they fell under control or the experimental group. The test was set following the guidelines of assessment and the required level of difficulty as specified in the syllabus.

3.6.3 Intervention

During the intervention, the participant learners of the *control group* were supported in a traditional way of teaching, i.e. they received printed notes and PowerPoint presentations, worksheets, and exercises on the topic (See Appendix G). The *experimental group* received notes and they were given exercises and homework in the afternoon just like the control group. However, they additionally received a Facebook intervention, where they were given the opportunity to listen to videos and teacher explanation postings on the group, pictures, additional PowerPoint presentations, and further study materials on the topic. They were also allowed to interact with fellow group members and teachers on Facebook around the topic.

During the five days of the study, learners in the *experimental group* were allowed an hour of Facebook time per day, while the *control group* received an hour of working on their exercises. The participants were strictly discouraged from sharing the information of the study during the time of data collection.

3.6.4 Post-test:

After 5 teaching days, a post-test was conducted. Both the control group and experimental group wrote the same post-test to test the effect of the interventions on the learners. The post-test results were then used to assess if there exists a significant difference between the control and experimental group score outcome. Whatever difference that might arise, it is believed to be caused by the interventions.

3.6.5 Observation in terms of study implementation

The researcher observed the actions of the participants during the intervention period (see observation instrument Appendix H). These involved the types of device the participant used or willing to use, the interaction between participants and between the participants and the teacher, amount of time spent online, participation, motivation among participants during the study, behaviour and ethical conduct of learners on the group, contributions, and freedom of expression.

3.7 Data analysis

The obtained data are presented with the aid of tables, percentages, calculations, graphs, and charts of different kinds. The data from the pre-test and post-test are compared, and statistical significance levels (the p-value or t-value) are calculated. The correlation is calculated in order to indicate a possibly significant level of Facebook use for learning support. In addition, the discussions from Facebook were analysed by tallying categories of 21st century learning support and providing a frequency table or graph to indicate what type of curricular learning support was identified on Facebook.

3.8 Reliability and Validity of the study

This study was conducted aiming to explore whether Facebook has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level in a selected school in the Oshikoto Region. As Grade 12 learners in the Oshikoto region are of the same age range, have the same NSSCO working scheme and syllabus in the region, and all schools follow a common set of rules as approved for the region, it is believed that Grade 12 learners in the region are of the same characteristic and they can be affected by the intervention in a similar way. Therefore, the results obtained can be generalised

to all Grade 12 learners taking Physical Science in the region.

When the pre-test average results of the control and experimental group are compared, there is a slight difference between them. Due to this slight difference between the two groups, the two groups are considered to be equivalent. Since the same test is administered in the post-test and the groups are initially considered equivalent then any difference between the groups average in the post-test is believed to be caused by the intervention.

3.9 Ethical consideration

Upon receipt of ethical clearance certificate (Appendix A) from the UNAM Centre of Research and Publications, permission was sought from the permanent secretary of the Ministry of Education (Appendix B) and from the regional directorate of education director (Appendix C). Before the commencement of the intervention, the researcher briefly explained the objective of the study to the participant. Participation in the study was voluntary. Hence the parents/guardians and learners were given an approval letter to sign (Appendix D) as a means to confirm the willingness of the learners to participate in the study. The participants were assured of the confidentiality of their responses and that their responses would only be used for research purposes. To ensure anonymity, learners were given identification numbers because the names of the participants were not required during the study. Every participant had an agreement not to discuss the experiment with their fellow classmates for the period of the study in order to eliminate or reduce contamination of data. It is important to note that Facebook privacy was upheld by creating a separate closed group for learners of the *experimental group* to join. The participants were informed about their rights to decline or withdraw from the study at any time should they feel pressured or intimidated by the questions asked. All data would be stored electronically in a

password-protected folder for four years and thereafter it would be deleted, while the test papers would be kept in the rocked cabinet for four years, and thereafter they would be destroyed.

3.10 Summary

This study used a quantitative approach with a quasi-experimental design to collect statistical information from 38 Grade 12 learners in a selected school in the Oshikoto region. The researcher obtained demographic information of participants through a pre-research questionnaire. A pre-test was piloted to test the initial level of equivalence between the control and experimental group. The post-test was then administered after the intervention to assess and evaluate the impact of the intervention on the above-mentioned groups. The ethical issues were considered during data collection and the analysis process.

CHAPTER 4: PRESENTATION AND DISCUSSION OF DATA

4.1 Introduction

This chapter presents the data collected through the pre-research questionnaire, pre–test and post-test, as well as the researcher observation to investigate Facebook as a learning support tool for NSSCO physical science grade 12 learners in the selected schools. The data were analysed, identified, described and the relationship between Facebook and physical science performance is explored. The learners' performance was critically analysed to capture essential data to accomplish the research objective. The researcher further observed clearly and analysed learners' interactions on the platform.

The overall aim of the study was to explore whether Facebook has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level in a selected school in the Oshikoto Region. This study focuses on the hypothesis:

H_0: There is no significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

H_1: There is a significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

4.2 Characteristics of the participant school

The selected school is a rural secondary school about 16 kilometres from the main road in the Oshikoto region, with a grade range from 8 -12. The school offers only one field of study Science (with either: Geography, Accounting, or Agriculture) at Grade 11 and

12 levels. The school has no computer lab. However, it has a school library with 7 computers for learners to use. In addition, the school is equipped with electricity and Wi-Fi connections around the administration block and classes. All the learners are accommodated in the school hostel.

4.3 Demographic information

The demographic information of participants addresses the age, gender, and devices used during the study.

4.3.1 Age group

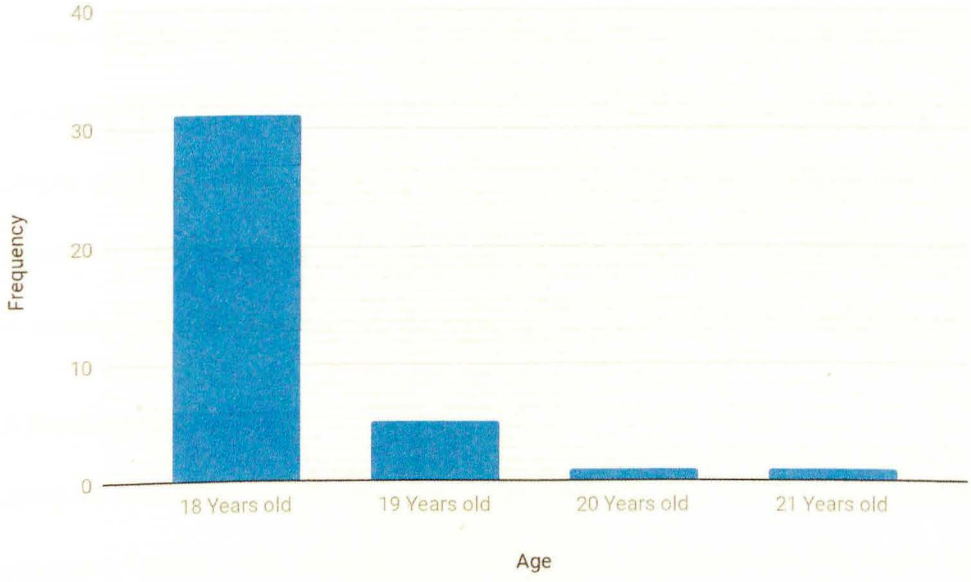

Figure 2: Age group of participants

Participant learners were all in the age range of 18 to 21 years old as it is considered the normal age group of learners at secondary school. The modal age group is 18 with 81.6 % followed by 19 with 13.2 % and the least being 20 and 21 with the same percentage of 2.6 % each.

4.3.2 Gender

Table 1: The number of participant learners as per their gender.

Gender	The distribution of girls and boys to the study groups		Total
	Control Group	Experimental Group	
Girls	11	7	18
Boys	8	12	20
Total	19	19	38

As indicated in Table 1 above, the participant learners' ratio of boys to girls was 10:9. The *control group* consisted of 57.9% girls and 42.1% boys, while the *experimental group* consisted of 39.8 % girls and 63.2% boys. Although more girls than boys have Facebook accounts, most of the girls indicated not being comfortable using their Facebook account to interact with the teacher. They prefer to use their account for social means with their peers and not for education where the teacher is involved.

4.3.3 Device used

A variety of technologies were available to the learners. **Fig. 3** shows the percentage of participant learners who used specific technological devices during the intervention as per the observation of the researcher.

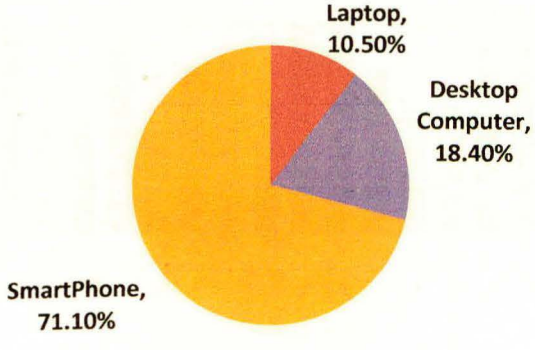

Figure 3: Devices used by participants

Despite the school making 7 computers available in the library, participant learners preferred taking along and using their personal mobile devices. As indicated on the pie chart above only 10.5 % of the participant learners opted to use school desktop computers, while 18.4 % of the participant learners used laptops and the majority of participant learners forming 71.1 % of the sample utilized their smartphones.

4.4 Facebook as a learning support tool

The pre-test and post-test were used to measure learners' performance to determine the existence of a significant difference between the outcome scores of the experimental and control group, the pre-test and post-test outcome scores were analysed in different charts, tables and t-values are calculated at $\alpha = 0.05$.

4.4.1 Pre-test outcome score

The pre-test assessed the initial learners' level of understanding and the level of equivalence between the control group and experimental group before the intervention.

4.4.1.1 Control group

Figure 4 shows the pre-test outcome score marks for the control group.

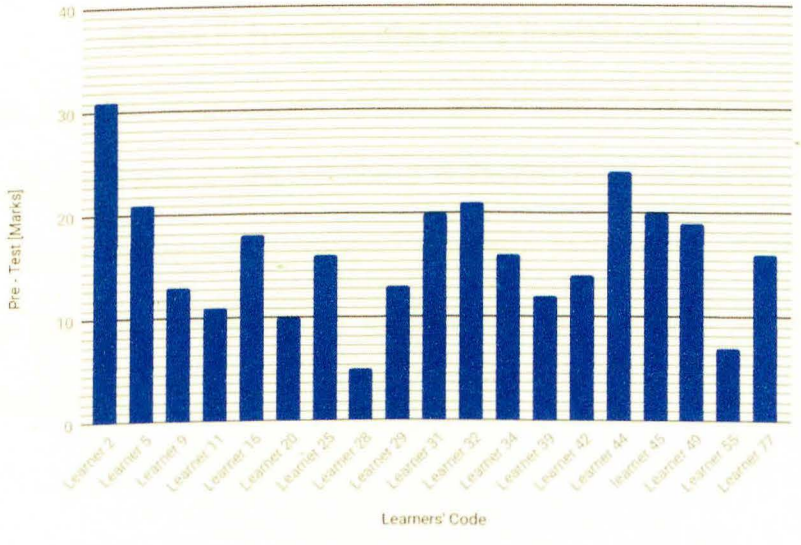

Figure 4: Control group pre-test score

As shown in Figure 4 above, on average, participant learners of the *control group* performed very poorly in the pre-test. Only 6 out of 19 learners (31.6%) of the *control group* participant learners have scored 50% and above in the pre-test. The average score of the control group in the pre-test is 16.2 out of 40; this made the average score percentage to be 40.5 % (a lower E symbol average).

4.4.1.2 Experimental group

Figure 5 shows the pre-test outcome score marks for the experimental group before the intervention.

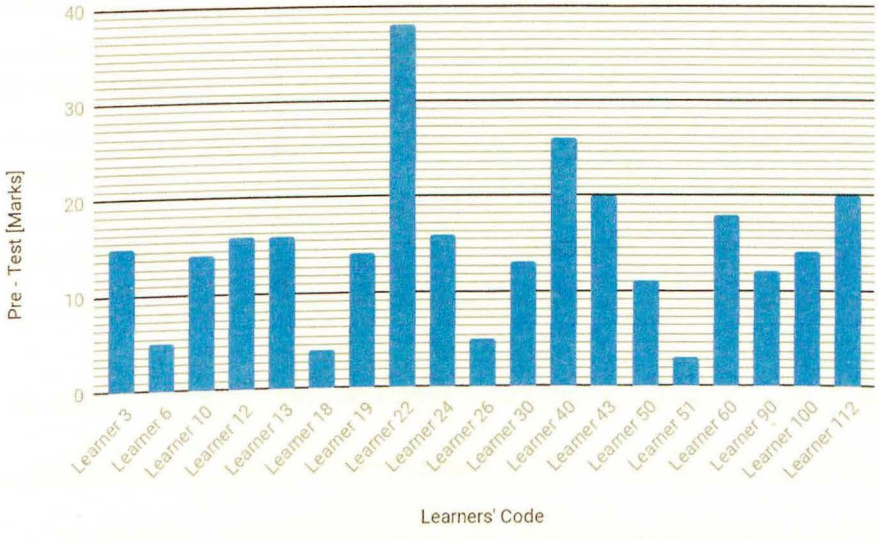

Figure 5: Experimental group pre-test score

As indicated in the column chart above, only 4 out of 19 participants in the *experimental group* scored 50% and above in the pre-test. The average score in the pre-test for *experimental group* participant learners is 14.7 out of 40, forming up 36.8 % average percentage score in the pre-test. (Or an F average symbol for the *experimental group*).

4.4.1.3 Pre-test outcome score: control versus experimental group

Table 2: Pre-test score statistical calculations

Statistical Calculations	Value	
	Control group	Experimental group
No. of participants	19	19
Mean	16.157894737	14.736842105
Variance	38.02923977	67.09356725
Standard deviation	6.166785205	8.191066307
Standard error	2.3521860722	
Degree of freedom	36	
T - value critical	2.750	
T - value calculated	0.604141249	

Table 2 shows the pre-test score statistical calculations: Mean, Variance, standard deviation, standard error, and t - critical value = 2.750 obtained from the table at α = 0.05 and the calculated t - value = 0.604141249 with the degree of freedom equal to 36. T - critical is greater than t - calculated.

4.4.2 Post-test

The post-test was administered after the intervention with the intention to assess the knowledge acquired by the participant during the interventions. Any change in the post-test outcome score is considered to be caused by the intervention.

4.4.2.1 Control group

Figure 6 presents the post-test outcome score for the *control group.*

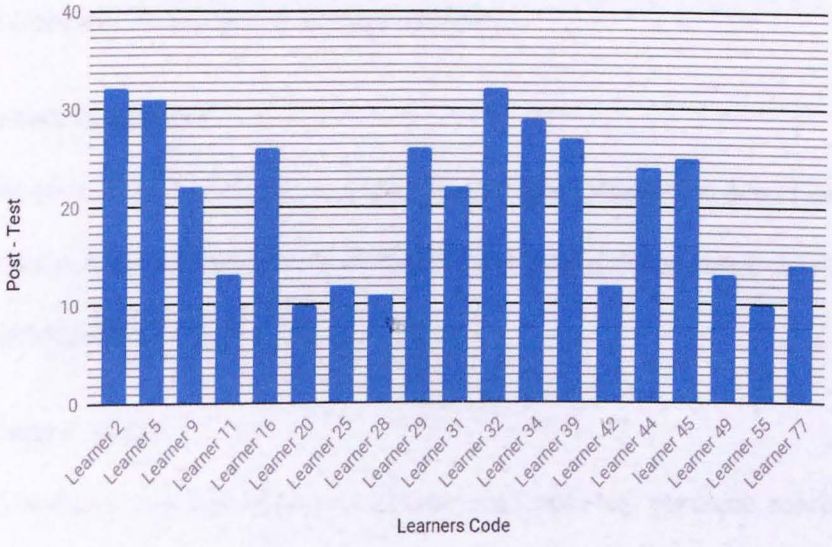

Figure 6: Control group post-test score

The control group participant learners performed quite well in the post-test, 11 out of 19 of the participants scored above 50%. The average outcome score for the control group in the post-test is 20.6 out of 40 (forming up 51.5% or a D average symbol).

4.4.2.2. Experimental group

Figure 7 displays the post-test outcome score for the *experimental group.*

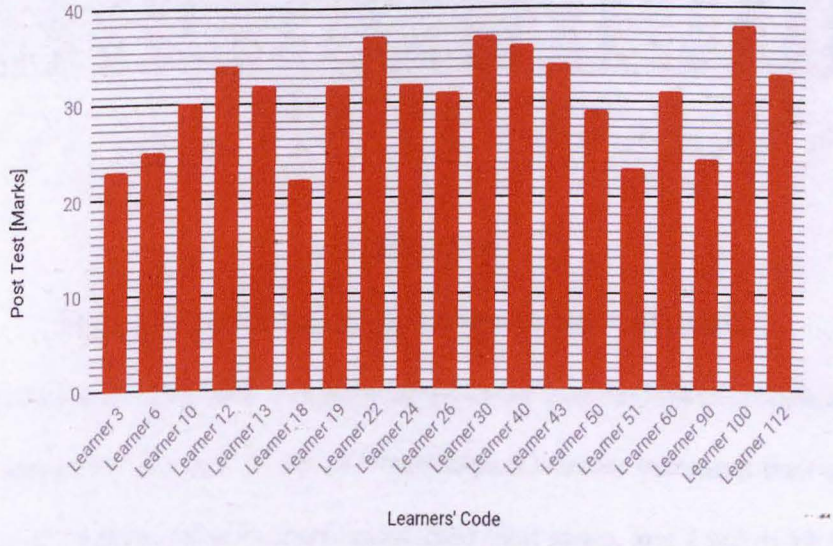

Figure 7: Experimental group post-test score

As reflected in Figure 7 above all participants in the experimental group have scored above 50% in the post-test, the mean post-test score for the experimental group is 30.7 out of 40 (forming 76.8% or a B average symbol).

4.4.3 Pre-test vs post-test

The results are critically analysed in Figure 8 and Figure 9 below to detect any change in the outcome score of participants during the two stages of the research (before and after the intervention).

4.4.3.1 Control group

Figure 8 illustrates the comparison of pre-test and post-test outcome scores for the control group participants.

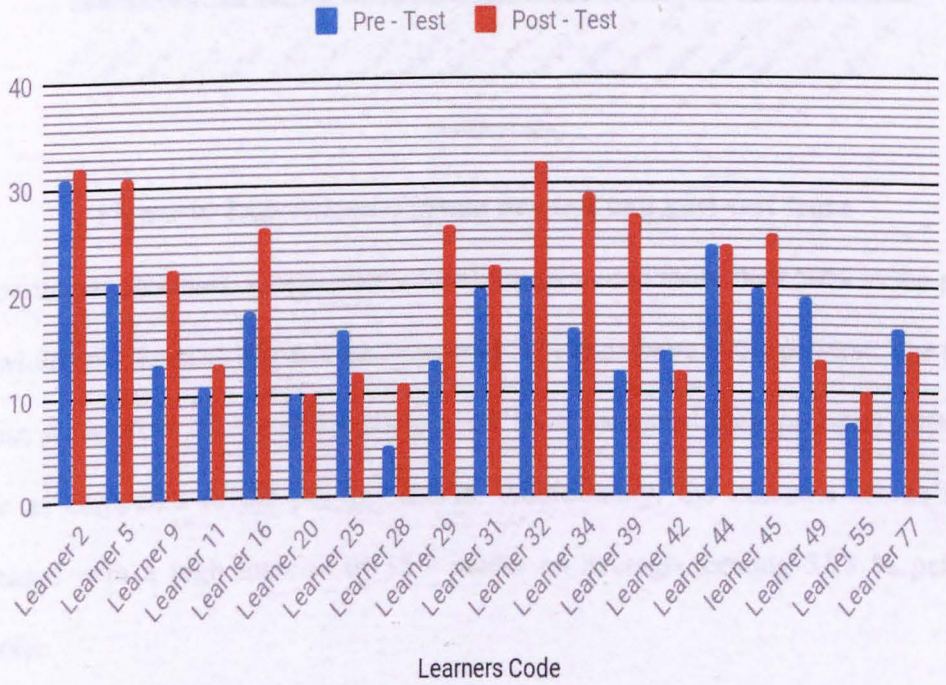

Figure 8: Control group pre-test and post-tests score

There is an increase in outcome scores obtained in the post-test when compared to the outcome score of the pre-test. 15 out of 19 participant learners increased their outcome score, 2 out of 19 participant learners maintained their score, and 2 out of 19 dropped

after the intervention. On average, there is a difference of 4.4 outcome scores between the pre-test and post-test, this forms a 27.1 % outcome score increment.

4.4.3.2 Experimental group

Figure 9 displays the comparison of pre-test and post-test outcome scores of the experimental group participants.

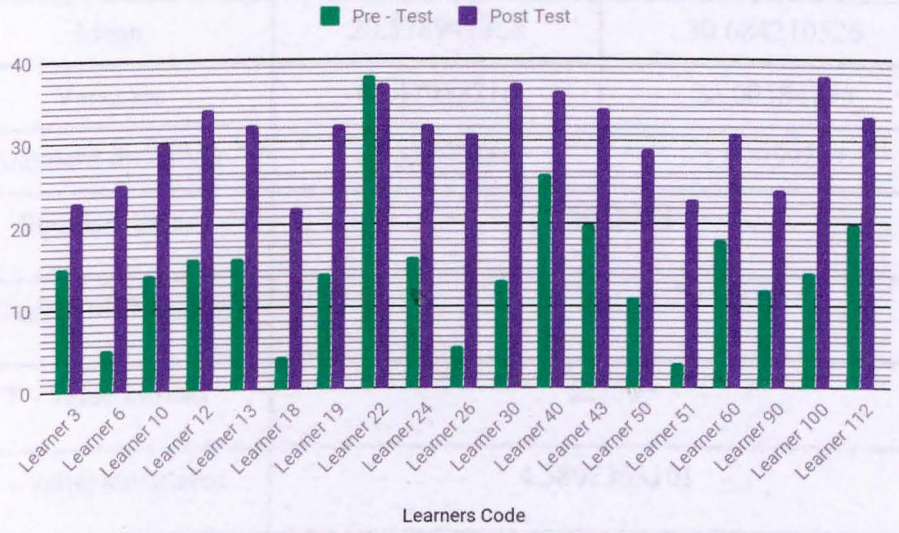

Figure 9: Experimental group pre-test and post-test score

All participant learners in the experimental group scored more than 50% in the post-test while only 4 out of 19 participants scored 50% and above in the pre-test. The table further shows that 18 out of 19 participants have increased their post-test outcome score as compared to the pre-test scores. Additionally, the outcome scores have increased with a high interval of 15.9 marks on average forming 51.8 % percent increase.

4.4.4. Post-test: Control versus Experimental Group

Table 3: Presents the post-test score statistical calculations.

Statistical calculations	Value	
	Control Group	Experimental Group
No. of participants	19	19
Mean	20.578947368	30.684210526
Variance	66.47953216	26.00584795
Standard deviation	8.153498154	5.09959292
Standard error	2.2062755	
Degree of freedom	36	
T - value critical	2.750	
T - value calculated	4.5802363101	

Table 3 present the post-test statistical calculations: Mean, Variance, Standard deviation Standard error of both the experimental and control group. The table further shows the t - critical value = 2.750 as obtained from the table at $\alpha = 0.05$ and t-calculated value = 4.5802363101 with a degree of freedom equal to 36. T - Critical is less than t - calculated.

4.5 Learning Support

During the intervention, the researcher observed the actions and behaviours of participant learners online. This was done to identify how Facebook supports teaching and learning, as well as to identify the benefits and advantages brought forward by the use of Facebook as a learning support tool in teaching and learning.

4.5.1 Facebook provides a means of motivation

Digital content is more motivating. When compared the handwritten content on the blackboard and the educational content accessed on Facebook, learners were more involved on Facebook than in class. This is further proven by the control group students who felt left out as they are not part of the Facebook (experimental) group. On the platform, learners demonstrated a high level of intrinsic motivation. Instead of depending on the teacher's activity or waiting for the teacher to come up with a task, participant learners took up the challenge to explore and identify suitable activities which they share and attempt to solve with others in the group. Adding to that, participant learners could collaborate and participate in discussions on their own without the influence of the teacher and some learners posted encouraging words motivating others to work hard or to be fully involved in the study as shown on figure 10, 11 and 12 below.

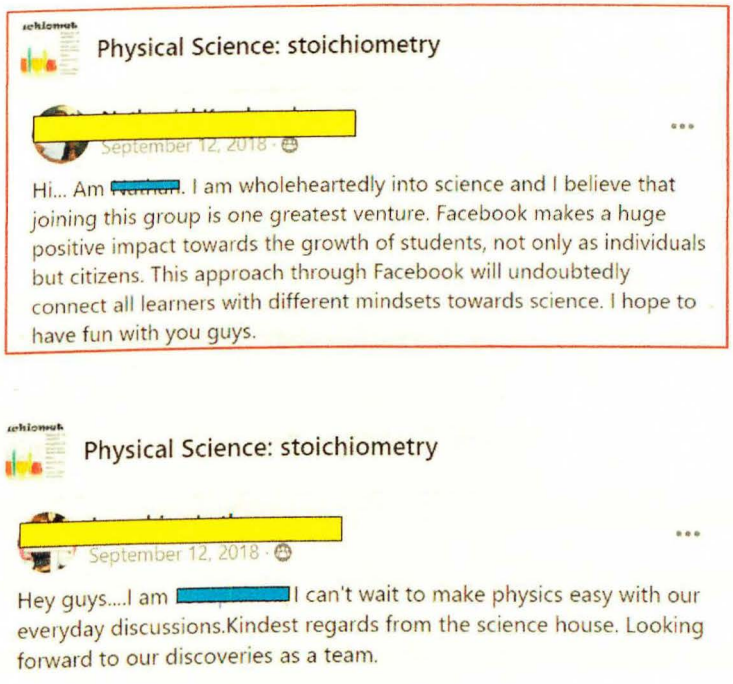

Figure 10: Students introducing themselves and expressing their motivation to participate on the group.

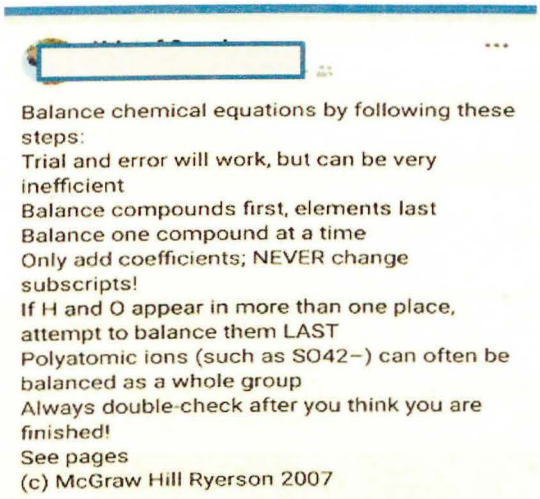

Figure 11: Student explaining to fellow students how to best balance the equations and giving the copyright from where she found the material.

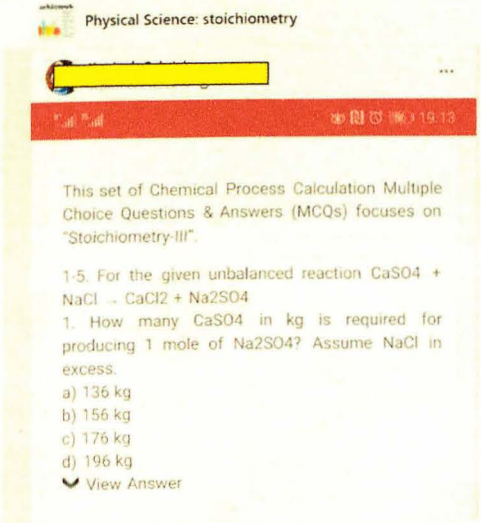

Figure 12: Student adding additional exercises for their peers to complete.

4.5.2 Meeting slow and fast learners' needs (Equity)

Unlike in traditional teaching where teachers may not use various methods of teaching due to lack of resources (projector, camera, audio recorder, and player, etc.), on Facebook the teacher presented the lesson using various ways (That include auditory, visual and kinaesthetic) to accommodate all learners based on their needs, capabilities and learning styles. Different media formats such as pictures, videos, diagrams, and

audios were uploaded on Facebook and were used to deliver the lessons. In addition, more activities and sites were shared, this allowed fast learners to further read/learn on their own gaining extra knowledge and information as per their learning capacity and ability.

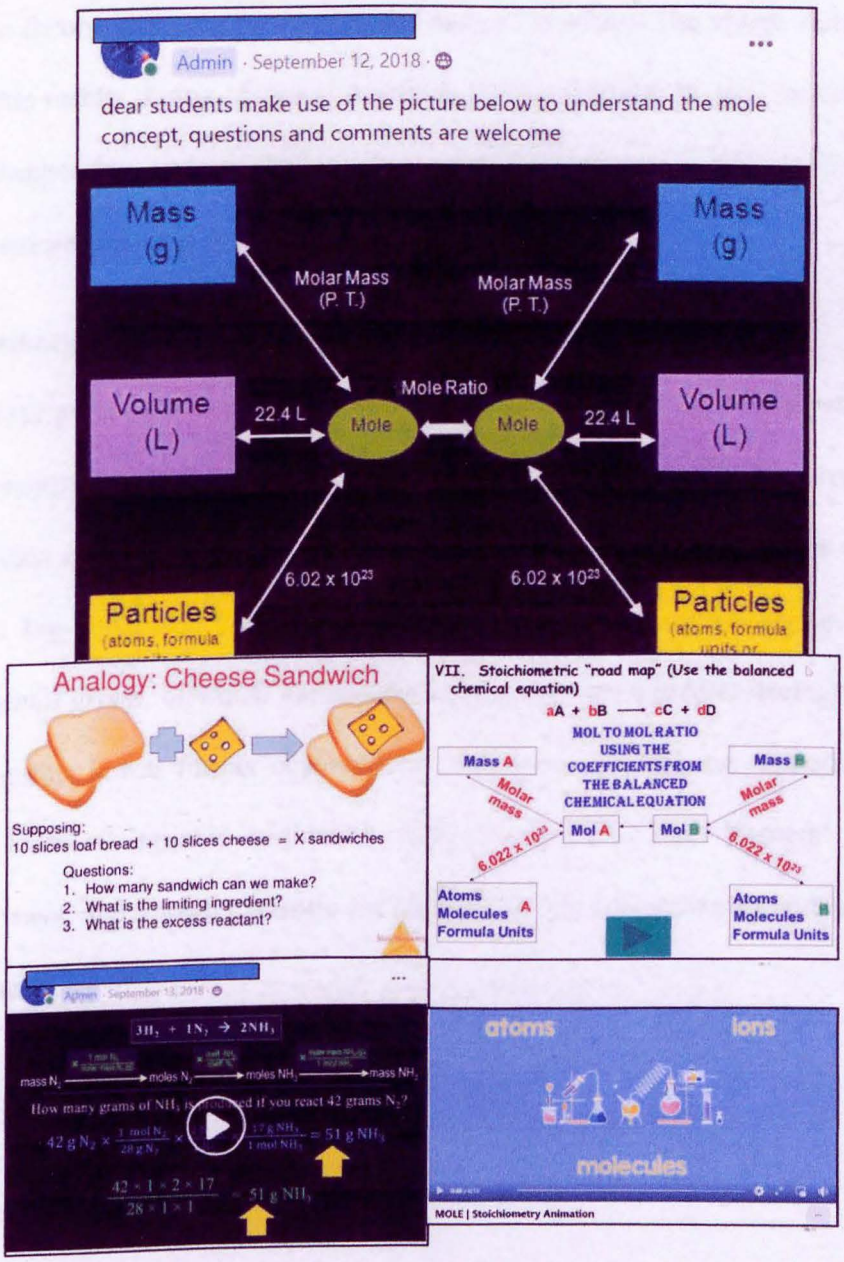

Figure 13: A variety of diagrams, videos and approaches used during the teaching and leaning on the Facebook group.

4.5.3 Exposure for all students to real-life examples and laboratory experiences

Participant learners are exposed to real-life situations through simulation videos and modelling. Videos that show how chemical reactions take place are uploaded. These videos show the moles and ratio of reactant, action of how the particles react by Collision theory, expected product(s), and amount in moles. The videos further show observable results during chemical reactions such as bubbles of gas, colour change, chips disappearing, and observable effects of external factors to the rate of reaction, such as temperature, catalyst, size of particles, etc.

4.6 Summary

Most of the participants preferred using smartphones to participate in the study. The pre-test score showed a low average for both the control and experimental group. Also, the t-critical value is greater than the t-calculated value. However, the post-test score shows a big difference between the mean score for the *control group* and the *experimental group*, of which the experimental group had a greater average than the control group. It was further observed that Facebook is a learning support tool that enables learners' intrinsic motivation, allows teachers to meet learners' needs in various ways, and allows exposure for learners to real-life examples and laboratory experiences.

CHAPTER 5: CONCLUSION, SUMMARY, AND RECOMMENDATION

5.1 Introduction

The study focused on exploring whether Facebook has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level in selected schools in the Oshikoto Region. This research study tested the hypothesis:

H_0: There is no significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

H_1: There is a significant difference in the learner's academic performance in NSSCO Physical Science on the topic of stoichiometry when Facebook is used as a learning support tool.

This chapter presents a summary of the major finding of the study, the limitation, and challenges experienced during the study that hindered the effectiveness of the data collection, as well as recommendations for further research in this area.

5.2 Summary of the major finding of the research study

5.2.1. Before the intervention

As indicated in Chapter 4, all participants of the study (the *experimental* and *control group*) had an equivalent level of knowledge and understanding. This was proven by the pre-test results in which both groups of participant learners scored marks below 50 percent, which resulted in a low average. In addition, the calculated statistical value (t-value = 0.604141249) at $\alpha = 0.05$ with a degree of freedom of 36 was less than the critical t-value (=2.750). Therefore, there was no significant difference between the *experimental* and *control group* score marks at the initial stage of the study.

5.2.2. After the intervention

It was observed that the mean score of the *experimental group* highly increased exceeding the mean score of the control group. Secondly, all the participant learners in the *experimental group* scored above 50% in the post-test while only 11 out of 19 of the control group participant learners scored 50% and above in the post-test. In addition, although there was an increase in marks for both the control and experimental group result from pre-test to post-test, the average mark increase for the *experimental group* (= 16 or increase by more than 100%) and was higher than the average marks increase of the *control group* (= 4.42 or increase by 27.4%). It is further noticed that the calculated statistical value after the intervention (t-value = 4.5802363101) at α = 0.05 with a degree of freedom of 36 is greater than the critical value (t - critical =2.750). Therefore, it can be stated that a significant difference between the control and experimental score marks existed when Facebook was used as a learning support tool. These results reject the null hypothesis and accept the alternative hypothesis.

5.3 Link Research to Framework

The researcher and the students used Facebook in an educational focus to achieve the common goal of improving performance and understanding of concepts. The researcher took up the role of facilitation. Whereby he posted instructions, directed questions to the learners, motivation posts, guidelines, feedback as well as uploading notes, pictures and videos (Learning materials) necessary to boost learners understanding or to improve learners' knowledge and to relate learners to real-life situations. The researcher ensured that learners had adequate supportive learning resources, evaluated the validity of the material/content shared by the learners, and stimulating learners' involvement in discussions and collaboration. Students, on the other hand, contributed to the goal through the role of asking and answering questions.

The mediation processes of the social learning theory: attention, retention, reproduction, and reinforcement were observed during the study.

5.3.1 Facebook encourages Attention

The Social Theory Model refers to the actor engaging in the observed behaviour, learners pay attention to the model and encode their behaviour for imitation. For this study, many students already had Facebook accounts on which attention and engagement exist for social interaction. Learners are summoned by hundreds of peer voices, likes, @mention, and comments across a shared digital space. This maintains and redirects a focus interaction between learners and a leam of available knowledge throughout the duration of the learning activities (Deaton, 2015).

5.3.2 Facebook encourages Retention

Facebook provides visual and audio stimuli in the form of graphics, video, charts & graphs, annotations in peer comments, and the ability to interact with the information in the live setting. These allow students to clear mental images and hence allow learners to remember observed behaviour and reproduce or imitate such behaviour later.

5.3.3 Facebook Facilitate Reproduction

Reproduction is the ability or a will to perform the actions or Behaviour of the model. Facebook creates a platform for interaction as learners are exposed to their peers, parents and experts. This increase learners' exposure to a variety of behaviour (interactions) that boosts learners' self-efficacy resulting in a strong desire to participate in the diverse community. In addition, digital interaction is detached from social anxiety and encourage high level of engagement (Deaton, 2015). For this study, the discussion phase is characterized by learners assisting other learners in

understanding the concept taught. Within the discussion sections, learners can not only display understanding by assisting others to understand but can add additional learning materials that aid in further understanding. This shows that Facebook enhanced reproduction.

Facebook was used as a collaborative platform, on which the researcher facilitated the discussion and interaction of participant learners helping them to learn from each other and to be creative and innovative. The researcher played a role by posting concepts and open-ended questions allowing learners to discuss, express themselves, and explain how they arrived at their answers or conclusions. In addition to the ongoing discussion facilitation and interaction with the participant learners, the researcher had to endorse final answers, correct learners where they went wrong, and explain concepts to ensure that all learners have the same understanding of the concepts. It was observed that learners possess an intrinsic motivation and demonstrated the 21st century learning skills, such as being actively involved in the discussion and effective collaboration, using Facebook as a means for effective communication, being creative, and thinking critically to solve given problems and answer the posed questions.

5.3.4 Facebook facilitates Reinforcement

The researcher observed and responded to the behaviour of the learners in the group by giving learners rewards or punishment. In addition, learners received positive or negative reinforcement from their peers and also observed the reinforcement for their peers' behaviours or actions. Therefore, learners identify models or behaviours that are seen as rewarding. For this study, it is evident in the result of the post-test that during the interaction on Facebook learning has taken place. This is because the experimental group learners have scored very high marks in the post-test than the pre-

test. The same shift in score did not happen in the control group where Facebook is not used.

5.4 Limitations

In setting up the learning support environment, there were certain limitations that required highlighting in order for future studies to improve upon. The following were the limitations of the study:

1. **Technological Resources**

Personal telephones are not allowed in schools, even though permission was granted, learners could only use the devices (smartphone) at specific given time and at identified places in order to adhere to the school rules and regulations. As the researcher had to keep the devices and only hand them to the participants during a specified time frame, Facebook was not used anytime and anywhere as in a real-life setting.

2. **Learners conduct with the phone and online behaviour**

It was out of the researcher's power to monitor the behaviours and activities that learners may have been engaged in during the study. However, the researcher was at a position to monitor what the learners were posting in the group, but not other activities that learners could be doing with their phones that may not have been in line with the schools' rules and regulations.

3. **Internet connectivity and access**

At times the school Wi-Fi was experienced to be slow which made it difficult for the participant to log in and participate in the discussions and activities on the Facebook platform. However, the researcher took the responsibility to use Tethering and Portable Wi-Fi hotspot to connect the participant learners to the Internet.

4. **Gender equity and protection**

Although more girls are enrolled on Facebook than boys amongst the study sample, most of the girls indicated not being comfortable to use their Facebook account to interact with the teacher and they indicated that they do not want the teacher to know their Facebook names. They preferred to use their account for social means with their peers and not for education where teachers were involved.

5.5 Strategies for teachers when using Facebook in teaching and learning

Teachers are urged to follow the below-mentioned strategies. Details explanation and step-by-step guidance, about how to use the features of Facebook in teaching and learning are given on www.FacebookForEducators.org.

1. The educators in consultation with parents and the education community should develop and follow the ICT policy for the school. Such policy should incorporate the use of Facebook and other social media in teaching and learning, clearly expressing how such Media can help the school achieve their goals other than distracting the education goals. The policy should be aligned to the national blueprints more specifically the national ICT policy in Education. In addition, the school ICT policy should be reviewed regularly to stay current with the fast-changing technologies and social media features.
2. **Students should be encouraged to follow Facebook's guidelines:** Teachers should refer and consider children's online protection. These include an age limit and encouraging students to utilize a report abuse button when they experience threats, offensive or abuse, bullying, or any inappropriate behaviour online. In addition, educators should familiarise themselves with the Facebook Community Standards and expose such standards to the learners as part of the discussion about appropriate online behaviours.

3. **Teachers should stay up to date about safety and privacy settings on Facebook**: educators should review and understand the Facebook safety settings to stay current with what is right for them and their learners. Time should be devoted to explaining to learners the safety issues and how to use the privacy settings effectively.
4. **Promote good citizenship in the digital world:** As the use of Social media/Networks and Online platforms increases in teaching and learning, teachers and learners are cautioned to adhere to the elements of digital citizenship. It is significant that learners are given proper guidance on how to be respectful and courteous to others online and offline. Therefore, teachers should set expectations of learners in their cultural association outside school, build a sense of online community and instil a sense of responsibility for good digital citizenship in learners. Teachers, parents, and the community should combat cyberbullying and promote a healthy and safe online community.
5. **Use Facebook pages and groups to communicate with learners and parents:** Teachers should use closed groups and pages to communicate, collaborate, interact and share content with the learners and parents in an appropriate and professional manner.
6. **Embrace the digital, social, mobile, and "always-on" learning styles of 21st Century students:** A large number of learners have access to mobile phones and the internet, therefore educators are urged to use such opportunity to bring instant access to learning through teacher moderated Facebook pages, chat, and groups keeping learners in learning mode outside the classroom.
7. **Use Facebook as a professional development source:** Educators should create and or join subject groups on Facebook to collaborate in their region,

nationally or internationally, sharing content, notes, and presentations, assessment activities and best practices, and teaching strategies on how to use Facebook and other social technologies in the classroom to improve learners' performance.

5.6 Recommendation

The findings of this study proved that Facebook and other social media can be sourced as a medium for creating learning support for learners to improve their performance. Certain critical issues need to be addressed and further investigated:

a. Teacher Training Institutions should produce a larger critical mass of teachers who are capable of setting up a learning environment on social networks and who can communicate proficiently and ethically with their learners to create online learning environment. This means that teacher training institutions need to model and inspire future teachers to use the technologies appropriately to support learning. Social media plays a positive role in enhancing and improving academic performance (Al-Rahmi & Zeki, 2017) as it supports the constructivist approach to learning (Hamid, Waycott, Kumia, Chang, 2015). Social media has a valuable role in facilitating the collaborative learning and engagement of students, teachers, and other education stakeholders in the learning process (Al-Rahmi, Othmsn & Yusuf, 2015).

b. Teachers should update themselves through MOOCs on how to utilize Facebook and other online platforms to improve teaching and learning.

c. The Ministry of Education Art and Culture (MoEAC) should strengthen CPD targeting on improving the use of online platforms and media in teaching and learning.

d. ICT should be integrated throughout or across the curriculum to ensure that learners are exposed as from early age. The MoEAC has incorporated ICT in the revised national curriculum from the early grades to grade 12. The incorporation of ICT into the national curriculum will develop the learner's knowledge and understanding of the nature of information and information processes, and the usage of ICT equipment and networks. The following skills in using ICTs will be developed: 1. To process and present information, 2. Creativity and the ability to innovate ICTs, 3. An understanding of the importance of ICTs for development (MoEAC, 2016). However, teachers, school management, parents, the respective communities, and all educational stakeholders are to play a vital role and give a positive force to ensure that the curriculum is effectively and efficiently implemented and that it serves its purpose.

e. Parents and community play a vital role in the ICT integration, therefore the schools have the responsibility of including the parents and form partnerships with NGOs, Churches, Civic groups, and local businesses in order to promote and improve integration and awareness of ICT in schools and in the society. Society should be trained through community libraries and development centres on how to manage the use of the Internet and mobile devices by their learners for educational purposes in social settings other than prohibiting the use of social media completely.

f. The local governments, youth centres, and community centres should develop programs to explore low-cost ICT alternatives, raise awareness of new ICT tools, approaches and merging ICT opportunities in society.

5.7 Conclusion

The use of Facebook as a support tool has shown that it has the potential to support learning and mastery of Physical Science to improve learners' academic performance on the topic of stoichiometry at Grade 12 level. This study showed that the learning support environment encourages the 21st Century learning skills (4 Cs). Further research is needed to show teachers how they can approach and setup Facebook for learning support based on the recommendations. In addition, research on mobile pedagogies and strategies is needed for teachers if they were to integrate Facebook as their learning support tool. The relevance of this study shows that teachers can no longer hide from using technologies that learners are so easily attuned to.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE CERTIFICATES

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: FOE/255/2017 **Date: 27 September, 2017**

This Ethical Clearance Certificate is issued by the University of Namibia Research Ethics Committee (UREC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the Faculty/Centre/Campus Research & Publications Committee sitting with the Postgraduate Studies Committee.

Title of Project: FACEBOOK AS A LEARNING SUPPORT TOOL FOR NSSCO PHYSICAL SCIENCE GRADE 12 LEARNERS IN SELECTED SCHOOLS IN THE OSHIKOTO REGION, NAMIBIA

Researcher: Amunime Leonard Amutenya

Student Number: 200612981

Faculty: Faculty of Education

Supervisor: Dr. P. J. BOER (Main) Mr. E. Haipinge (Co)

Take note of the following:

(a) Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the UREC. An application to make amendments may be necessary.
(b) Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the UREC.
(c) The Principal Researcher must report issues of ethical compliance to the UREC (through the Chairperson of the Faculty/Centre/Campus Research & Publications Committee) at the end of the Project or as may be requested by UREC.
(d) The UREC retains the right to:

(i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
(ii) Request for an ethical compliance report at any point during the course of the research.

UREC wishes you the best in your research.

Prof. P. Odonkor: UREC Chairperson

Ms. P. Claassen: UREC Secretary

APPENDIX B: PERMISSION LETTER FROM THE EXECUTIVE DIRECTOR (MOEAC)

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

Tel: +264 61 -2933200
Fax: +264 61- 2933922
Enquiries: C. Muchila/ G. Munene
Email: Cavin.Muchila@moe.gov.na/gm12munene@yahoo.co.uk

Luther Street, Govt. Office Park
Private Bag 13186
Windhoek
Namibia

File no: 11/1/1

Mr. Amunime Leonard Amutenya
P. O. Box 11888
Oshakati
Cell: 081 308 5818

Dear Mr. A. L. Amutenya

SUBJECT: PERMISSION TO CONDUCT RESEARCH IN OSHIKOTO REGION

Kindly be informed that permission to conduct an academic research for your Masters of Education degree on *"Exploring the Use of Facebook as a 21st Century Learning Tool for NSSCO Physical Science Grade 12 Learners in Selected Schools in the Oshikoto Region"* in Namibia, is here with granted. You are further requested to present the letter of approval to the Regional Director to ensure that research ethics are adhered to and disruption of curriculum delivery is avoided.

Furthermore, we humbly request you to share your research findings with the Ministry. You may contact Mr. C. Muchila/ Mr. G. Munene at the Directorate: Programmes and Quality Assurance (PQA) for provision of summary of your research findings.

I wish you the best in conducting your research and I look forward to hearing from you upon completion of your study.

Sincerely yours

2013-07-27

SANET L. STEENKAMP
PERMANENT SECRETARY

Date

All official correspondences must be addressed to the Permanent Secretary

APPENDIX C: PERMISSION FROM THE REGIONAL DIRECTOR OF EDUCATION OSHIKOTO REGION

REPUBLIC OF NAMIBIA

OSHIKOTO REGIONAL COUNCIL
DIRECTORATE OF EDUCATION, ARTS AND CULTURE

Tel (065) 281900
Fax (065) 240315
Enq: Ms H Tende

Private Bag 2028
ONDANGWA
09 August 2018

Ref: 12/3/10/1

Mr Leonard Amunime
PO Box 11888
Oshakati
Email: lnrd39@gmail.com

Dear Mr Amunime

RE: PERMISSION TO CONDUCT AN EDUCATIONAL RESEARCH PROJECT IN OSHIKOTO EDUCATION REGION

Our office acknowledges receipt of your letter dated 11 July 2018, seeking for permission from the Director to conduct a research study on exploring the use of Facebook as a 21st century learning support tool for NSSCO Physical Science grade 12 learners in Oshikoto Region. Kindly be informed that permission has been granted to you to carry out your research at Rev. Juuso Shikongo SS in Onankali circuit.

It is very important that your research does not interfere with the normal teaching and learning process at the school, any participation either by teachers or learners should be on a voluntary basis and the information to be gathered should only be used for research purposes. Please consult the school principal well in advance to make further arrangements

Thank you for showing interest to do research in Oshikoto Region. It is our sincere hope that the information you are going to get will be useful towards the completion of your qualification.

Yours faithfully

09/08/2018

MR LAMEK T. KAFIDI
DIRECTOR OF EDUCATION
OSHIKOTO REGION

OSHIKOTO REGIONAL COUNCIL
Director
09 AUG 2018
PRIVATE BAG 2028
ONDANGWA
DIRECTORATE OF EDUCATION, ARTS AND CULTURE

APPENDIX D: CONSENT LETTER FOR PARENTS

Enquiries: Amunime Leonard A
National Institute for Education Development [NIED]
Senior Education Officer [ICT]
Cell: 081 3085818
Email: lamunime@nied.edu.na

Dear parent/guardian

This letter serves to communicate that ..... Is among the learners selected to participate in the research for academic study: EXPLORING THE USE OF FACEBOOK AS A 21ST CENTURY LEARNING SUPPORT TOOL FOR NSSCO PHYSICAL SCIENCE GRADE 12 LEARNERS. It is against this background that s/he is requested to come along with her smartphone as from the Holiday on 03/09/2018.

The study is **not** intended to violate the school **rules** and regulation nor to interfere or hinder teaching and learning, but aiming at finding innovative ways to improve learners' performance, assess learners' response toward 21st century skills and to model the best practice of learners in current global society and digital world. Therefore, upon coming from the holiday, all participant learners are **strictly** expected to hand in their phone to the school **superintendent**. Learners must not by anyway carry the phone to the hostel or classes.

The superintendent is entrusted to keep the phone safe and only issue them to learners during the time of study intervention. **Participation in the study is voluntary, hence participants have a choice of either to participate or not.**

Yours sincerely

Amunime Leonard Amutenya

.....
Parents' Signature:

APPENDIX E: PRE -RESEARCH QUESTIONNAIRE

I am Amunime Leonard Amutenya (St No: 200612981), an M. Ed (Education Technology) student at the University of Namibia. And currently a **Senior Education Officer for ICT at NIED.** I am intending to conduct an educational research for my dissertation in order to fulfil the M. Ed requirements. My research topic is: "***Exploring the use of Facebook as a 21st century learning support tool for NSSCO Physical Science Grade 12 learners in selected schools in the Oshikoto Region, Namibia".*** My main supervisor: Dr. P. J. Boer and the co-supervisor: Mr. E. Haipinge. Please help me to complete this questionnaire honestly as this is for my academic purposes. Your answers are confidential and anonymous.

Note: your name is not required for this study, therefore please DO NOT write your name on this paper.

Please put a cross (X) in the appropriate box below

1. Gender

Male	
Female	

2. Age

16	
17	
18	
19	
20	
21	
22	

3. Are you willing to provide your Facebook name to be added and participate in the study?

Yes	
No	

4. If no, provide a reason for not willing to provide Facebook name or not willing to participate in the study

.....

.....

5. If you are to participate in the study, which devise do you prefer to use

.....

THANK YOU VERY MUCH!!

APPENDIX F: PRETEST - POSTTEST QUESTION PAPER

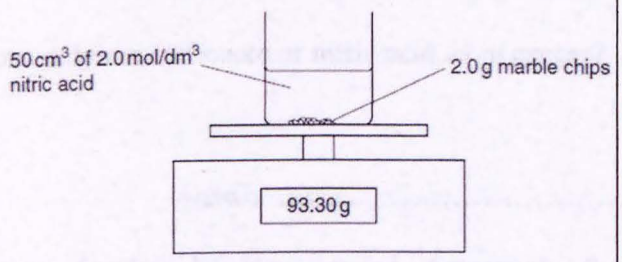
Learner code .....

1. Marble statuses are being damaged by acid rain. The chemical name for marble is calcium carbonate.

   A student investigated the reaction between marble chips and nitric acid.

   $$CaCO_3(s) + 2HNO_3\ (aq) \square Ca\ (NO_3)_2(aq) + H_2O\ (l) + CO_2\ (g)$$

   The diagram shows the apparatus the student used.



   The student recorded the balance reading every minute.

   The table shows the results.

time / minutes	balance reading / g
0	93.30
1	93.28
2	93.26
3	93.24
4	93.22
5	93.21
6	93.20
7	93.19
8	93.18
9	93.17
10	93.16
11	93.15
12	93.15
13	93.14
14	93.14

   a) Explain why the balance reading decreases during the experiment.

   ..... [2]

   b) How can a student tell that the reaction has finished? State two possible observations.

   .....

   ..... [2]

c) Calculate the number of moles of nitric acid in $50cm^3$ of $2.0mol/dm^3$ solution

Answer ..... [3]

d) Calculate the number of moles of calcium carbonate in 2.0g.

Answer ..... [2]

e) Which reagent, calcium carbonate or nitric acid, is in excess?

Answer ..... [3]

f) Find the volume of carbon dioxide produced. Assume that the reaction is carried out at room temperature

Answer ..... [4]

2. Fuel is used as a source of energy in our everyday life. The equation below shows the burning of fuel at room temperature and pressure.

$$C_3H_8 + O_2 \square CO_2 + H_2O$$

a) Balance the equation

..... [2]

b) If 0.6 g of CO_2 is released during the reaction, calculate the mass of fuel burned

Answer ..... [4]

c) What volume of O_2 is used in the reaction to produce the 0.6 moles of CO_2

Answer ..... [4]

3. Iron is extracted from its ore (Haematite) by reduction with coke in the blast furnace. The main reaction of this extraction is: Haematite reacting with carbon monoxide.

a) Write a balanced chemical equation for the main reaction

.....

..... [2]

b) Calculate the molar mass of Haematite

Answer ..... [2]

c) Calculate the mass of CO needed to react with the 25g of the ore

Answer ..... [3]

d) Calculate the mass of Fe produced from the 25g of the ore

Answer ..... [2]

e) Calculate the volume of the gas (CO_2) produced during this reaction

Answer ..... [3]

f) Calculate the mass of CO_2 gas produced

Answer ..... [2]

TOTAL [40]

APPENDIX G: TUTORIAL QUESTIONS (WORK SHEET)

Question 1.

When copper nitrate $Cu(NO_3)_2$ is heated, Copper nitrate decomposes to form copper oxide (CuO), Nitrogen dioxide (NO_2), and Oxygen O_2.

(a). write the balanced chemical equation for the above reaction.

..... (2)

(b). Calculate the relative formula mass (M_r) of copper nitrate

M_r = ... (2)

(c). How many moles of copper nitrate $Cu(NO_3)_2$ are in 9.4 grams of the compound?

Mole = ... (3)

(d). When 9.4 grams of $Cu(NO_3)_2$ is heated, how many moles of oxygen will be formed?

Mole =..... (3)

(e). Calculate the volume of oxygen gas produced at r.t.p by the complete combustion of 9.4 grams of $Cu(NO_3)_2$.

Volume = ... (3)

Question 2

(a). Calculate the concentration of 300 cm^3 potassium nitrate solution containing 0.5 moles

Concentration = ... (3)

(b). What is the concentration of a solution containing 15.5 grams of Sodium Chloride (NaCl) dissolved in 250 cm^3 of water?

Concentration = ... (3)

Question 3.

1. In an experiment copper (II) carbonate is added to 60 cm^3 of hydrochloric acid of concentration 0.9 mol/dm^3.

i. Write a balanced Chemical equation for this reaction

..... (2)

ii. Calculate the number of mole of HCl in 60 cm^3

Mole = ... (2)

iii. Calculate the number of mole copper (II) carbonate needed to react with the acid.

Mole = ... (2)

iv. Calculate the relative molecular mass (M_r) of copper (II) carbonate.
(A_r: C = 12, O = 16, Cu = 64)

M_r of copper (II) carbonate..... (2)

v. Calculate the mass of copper (II) carbonate.

Mass of copper (II) carbonate..... (2)

vi. Limestone ($CaCO_3$) is used in the production of lime (CaO) as shown by the equation below.

$$CaCO_{3\,(s)} \qquad CaO_{\,(s)} + CO_{2\,(g)}$$

28 tonnes of lime are required by a factory each week to make soda glass. Calculate how much limestone is required each week to produce lime. Show your working.

Answer .....tonnes (3)

Question 4

At r.t.p iron (iii) react with 250 Cm^3 sulfuric acid to form salt and hydrogen gas. Suppose 6 dm^3 of hydrogen is produced.

i. Calculate the mole of hydrogen produced from the reaction

ii. The moles of sulfuric acid used in the reaction

iii. The concentration of sulfuric acid used in the reaction

iv. The mass of iron used in the reaction in the reaction

Question 5

Write the chemical formula of:

a. Sodium chloride

b. Sodium oxide

c. Magnesium nitrate

d. Lithium sulfate

e. Iron(iii)carbonate

f. Calcium hydroxide

g. Ammonium sulfate

Question 6

a. How many moles of Mg are in 0.7g of Mg

b. Calculate the number of particles in 10g of oxygen molecules

c. Calculate the mass of 0.0023mol of aluminium oxide

Question 7

1. Calculate the volume of carbon dioxide gas occupied by 0.5mol CO_2 at stp.
2. Calculate the number of moles of ammonia gas, NH_3 , in volume of 72dm^3 , at rtp.]

3. In an oxygen producing reaction, a volume of $65dm^3$ of oxygen is produced.

   Calculate the mass of the gas produced during the reaction at. rtp.

APPENDIX H: OBSERVATION INSTRUMENTS

Learner Code: .....

1. Device used

Desktop computer	
Laptop	
Smartphone	

2. Participation during a session

	Yes	No
Commenting		
Posting		

3. Behaviour and Ethical Conduct

		Action taken
Good		
Bad		