UNIFYING THINKING, THEORY AND PRACTICE IN PHYSICS EDUCATION IN SOUTH SUDAN: A CASE STUDY OF SECONDARY SCHOOLS AND JUBA UNIVERSITY

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We confirm that the work reported in this thesis was carried out by the candidate under our supervision as university supervisors.

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Dedication

This work is dedicated to all physics teachers and students, you are wonderful change agents in societies.

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Abstract

The purpose of the study was to examine how teachers prepare learners for practical physics so as to enable them see connection between what they learn and its use in their daily life. Three objectives were set. These were; to establish the importance of experimental physics, to examine how teachers prepare learners for physics practical and to establish the relevance of ''learning essentials'' that translate theory to practices in everyday students' life using descriptive research design following qualitative research method. The methods used for data collection were interview, focus group discussion and documentary analysis. Results showed a marked awareness amongst students, teachers, government officials and development partners about the importance and purposes of practical physics and its application in everyday life and in bringing about societal transformation in a forth right manner. Results also showed that teaching of practical physics has taken up a methodology deeply rooted in theoretical dimension. Lack of laboratory facilities, trained teachers, inappropriate teaching methodologies were found to be responsible for this. South Sudan secondary school curriculum is rich in practical content but lack of support to it and existence of Sudan curriculum have hindered its implementation. I concluded that education stakeholders are aware of the importance of practical physics and its application in everyday life but the methodology does not enable learners to achieve its purpose. Teaching is done theoretically. I recommended for increased awareness, increased funding for practical physics, training and retraining of practical physics teachers, review of the curriculum, provision of laboratory facilities and equipments and introduction of vocational workshop in secondary schools.

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List of Acronyms

AAPT:	America Association for Physics Teachers
AET:	Africa Education Trust
EMIS:	Education Management Information System
GESAP:	General Education Strategic Action Plan
JDSSS:	Juba Day Secondary School Students
JUBUS:	Juba University Students
MoGE&I:	Ministry of General Education and Instruction
SEP:	Stanford Encyclopedia of Philosophy
SSDP:	South Sudan Development Plan
SSEMACESS:	Strengthening Science and Mathematics Education in South Sudan
UNEB:	Uganda National Examination Board
UTTP:	Unifying Thinking, Theory and Practice
ODI:	Overseas Development Institutes
TVET:	Technical Education and Training
SSSSC:	South Sudan Secondary School Curriculum
SST	Secondary School Teacher
JUBU	Juba University
GDP	Gross Domestic Product

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

It is my observation that there is no raised altitude on which thinking, theory and practice are united in physics education. On contradiction and complexities, Okello (2012)[1] noticed the margin that exists in our education system majorly created by absence of practicals. Sekamwa (1997) also noticed the non-relative importance attached to practicals as opposed to theory. Thus far, physics graduates hardly apply what they learn to solve real world problem yet emerging and a highly competitive, integrated and rapidly scientific and technological innovations continue to have a profound impact on our lives. In my opinion, physics should have been the would-be-a preferred platform for developing scientific literacy and building up essential scientific knowledge and innovation to meet the challenges posed by these changes.

According to Khaparde (2001), physics is a fundamental science, which provides a picture of how various systems in the universe behave and how the laws of nature operate under different conditions. It is strongly based on observations, measurements, data collection, analyses and interpretations. Given the very practical nature of physics, students develop an understanding of the practical applications of physics to a wide variety of other fields (Overseas Development Institute,ODI)[2]. ODI holds that with a solid foundation in physics, students appreciate the roles of physics in many important developments; in engineering, medicine and other scientific fields. However teaching physics is not uncommonly theoretical, a practice described by Rafagat (2012) published in Journal of Elementary Education as a body without soul.

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[1] Okello is a lecturer in faculty of Education, Department of Teacher Education and Development Studies, Kyambogo University. He presented a paper on contradiction and complexity on Technical, Vocational Education and Training on 7th March, 2012.

[2] obtained from the ODI homepage (http://www.emb.gov.hk/cd) and the webpage for physics teachers (http://www.hk-phy.org)

Making physics relevant in students' learning is an important aspect of physics education (Wan & Van, 2006). To Wan & Van, this involves the ability to apply concepts learned into everyday phenomena that students observe and experience around them. Hence, integration of practicals in students' learning is a defining aspect of physics education. From my experience as a physics teacher and student of physics, this method is particularly relevant in physics education where many of the concepts are abstract and generic. Indeed practical learning cannot be underestimated as Osborne cited in Dallion (2008) remarks that ''... the centrality of the laboratory to the teaching of science has become like the addicts' relationship to their drug – an unquestioned dependency which needs to be re-examined and weakened if not broken altogether...''.

The above views prompted this study to be grounded on realism theory. Realists hold that education should be concerned with the actual realities of life in all its aspect (Brennen, 1999). They further hold that problems and concepts presented in classroom must be similar to those students have encountered or are likely to encounter in life beyond the classroom. However realists' views seem to be running parallel with physics education practice in South Sudan.

In South Sudan, Physics is introduced as a subject in secondary schools. In the schools, students study physics in combination with biology, chemistry, mathematics and others leading to specialization in sciences. But Sudan curriculum -''the old Sudan'' never had any practical aspects in it. Practical was overdosed with ''anaesthetic'' and slept until 2005 after the war of liberation. Between 2005 and now, laboratory work has become an important part of science curriculum. The MoGE&I created a positive atmosphere for nurturing practical activities in different science subjects. As a result, the department for secondary education was directed in 2009 to procure practical and laboratory equipments to ensure that science subjects are taught practically in schools.

Regardless of this effort most physics students at secondary school and university levels still have problems in answering experimental physics questions as well as applying it in their daily life. This was evidenced by low scores attained in answering designed practical question and in some cases failure to attempt them. South Sudan Examination Secretariat reports (2011) points out that the majority of candidates had little knowledge on how to answer practical questions, leave alone relating it to their everyday life phenomenon. A similar report from Uganda National Examination Board (UNEB)[3] alluded to this weakness. In its report (2009; 2010 and 2011), UNEB consistently highlighted that South Sudanese Students do perform below average especially in practical exams.

This is not any different in Juba University. The Department of Physics at the University where I work is the leading physics institution in the country. It has a rather long history. As far as experimental physics is concerned, from personal experiences during practical sessions on Determination of Specific Heat Capacity of metals, a student asked me "Ustaz (teacher) give me temperature". This sounded very technical. I asked the Laboratory attendant to give the temperature to the students and I was very keen to see what he would give. Fortunately I observed him giving them thermometers which were meant for measuring temperatures of the cooling metal in the experiment. On a second occasion students again asked me to give them an angle instead of protractor when I was conducting an experiment on ''Measurement of Refractive Index of Glass in Air. It is therefore quite apparent that students could not differentiate between the quantity being measured and the associated instruments. As a realist, I must say that physics education in South Sudan hardly bare any seamless functionality with realists' view of education.

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[3] Uganda National Examination Board report is issues based of Signed Memorandum of Understanding with the Ministry of Education in the Government of South Sudan since 2009 to implement examination and issue certificate to students sitting for Uganda Certificate of Education examinations in South Sudan.

Informed by these experiences and institutional observations[4], I attribute students' inability in answering experimental questions correctly to inadequacy in the preparation processes in secondary schools. I therefore developed a concern to investigate the ways teachers are preparing learners for practical designed questions particularly in secondary schools so as to have this physics practical dilemma averted. I anticipate that if this is not done then we risk putting physics education on a full scale vocational drift. For greater success in practical physics, I conceptually proposed a unified approach to practical learning and indicated the key variables that affect it in figure 1.1.

1.2 Conceptual Framework

Unified approach to practical learning

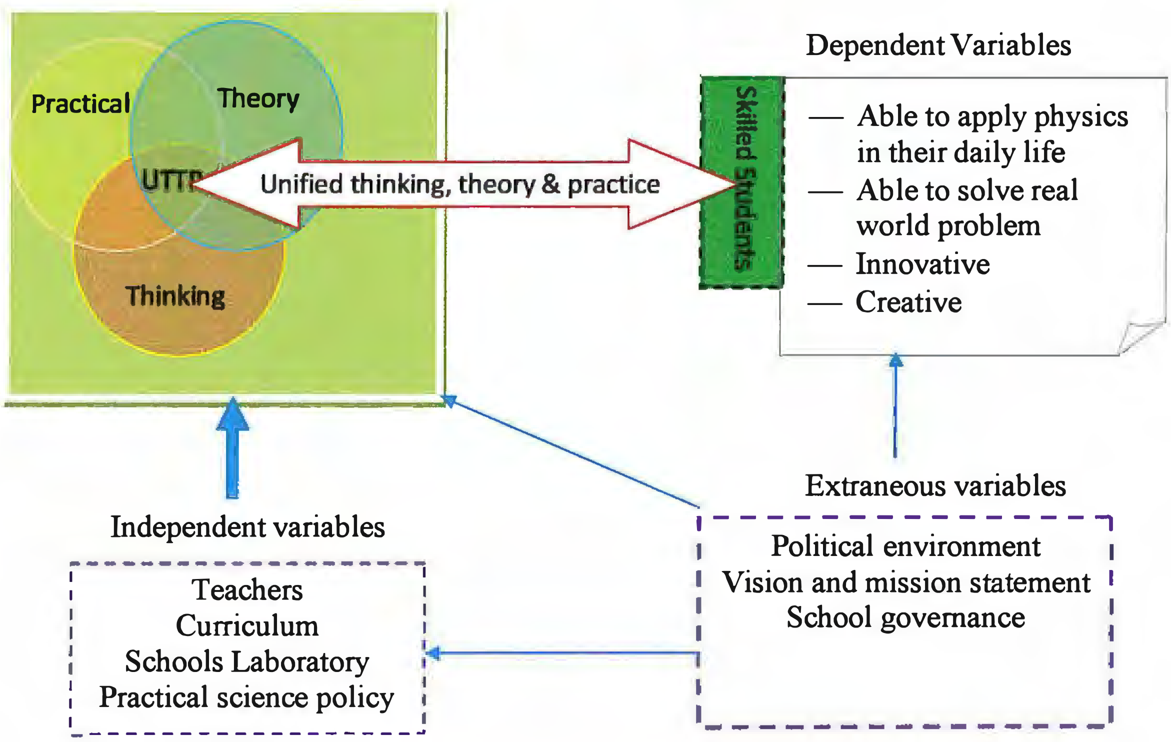

Figure 1.1

Source: Self constructed

Conceptual framework

[4] Uganda National Examination Board 2011 and South Sudan Examination Secretariat Report 2011

1.3 Explanation to the Conceptual Framework

The framework configures that skilled physics students depend on real "life pedagogy" where what is taught in classroom is practiced. It suggests that the best vocational practice is that where practical, theory and thinking are unified and taught as a coherent whole to physics learners. Therefore if the aim of education is to provide students with skills that they will use in their working life, option of treating the three as a unity must become prominent. Isolation of practical learning is the genesis of contradiction and complexities in our education system-qualifying that we don't follow our education objectives (Okello 2011)[5].

In the framework, there are independent factors that directly influence the quality of physics students: Skilled and practical physics teachers, practical curriculum and practical and financed science policy are all important determinants of physic graduates our schools produce. The framework suggests that if we have competent practical physics teachers, practical curriculum, and well resourced practical science (physics) policy then our schools will produce physicists who will apply the physics in their daily life hence transforming the society into technological society. A move that is most embraced by the whole world today.

Although indirectly, political environment, mission and vision statement of a country's education system significantly influence the quality of physics graduates. This is associated with political willingness to finance practical sciences and invest in physics graduates.

[5] Okello is a lecturer is Kyambogo University, Faculty of Education, Department of Teacher Education and Development Studies. His paper titled Vocational Education in African Context was presented on 14th October, 2011 to students pursuing masters of vocational pedagogy in kyambogo University

1.4 Statement of the Problem

Many physics candidates at secondary schools and university levels are facing challenges responding to experimentally tailored questions. This is because the preparatory process is not being adequately done by practicing teachers. The preparatory processes lack experimental pedagogical approaches to make science learning more meaningful and support learners in innovative scientific practices. Lack of experimental pedagogical approach makes scientific learning more difficult and inhibits innovative scientific practices. Candidly speaking, this makes students to fail to pursue their intended career choices where practical is a prerequisite for further study in specific career. Since the first laboratory equipments were distributed to secondary schools in 2009, no study was carried out to examine the teaching strategies used by physics teachers for designed practical question. This study was therefore intended to bridge the gap in the knowledge on practical education in South Sudan.

1.5 Purpose of the Research

The purpose of the research was to examine the teaching strategies used by physics teachers for design practical questions so as to enable students to see connection between their daily life phenomenon and physics. The goal was to identify the gaps downplaying the progress of practical physics and its application in the real world outside classroom.

1.6 Study Objectives

1. To establish the importance of experimental physics.
2. To examine how teachers prepare learners for designed practical lessons for use in their daily life.
3. To establish the relevance of ''learning essentials'' for translating theory to practices for use in students' daily life

1.7 Study Questions

1. What are the importance of designing practical physics questions?
2. How teachers prepare learners for designed practical lesson for use in their daily life?
3. How relevant are the "learning essentials" in translating theory to practice in South Sudan Context?

1.8 Scope of the Study

1.8.1 Geographical Scope

The research was conducted in Juba. Juba was selected because it has model secondary schools. Specific institutions included were Ministry of General Education and Instruction, Africa Education Trust (AET)-South Sudan Program, SSEMACESS-South Sudan Program, Juba University Department of Physics and Juba day secondary schools. All these are in Juba.

1.8.2 Content Scope

The content of this study was limited to information advocating for experimental physics. Specifically was limited to those information that give teachers pedagogical skills for preparing learners for designed practical lesson. A boundary condition was also created that seeks information on the ''Learning Essentials'' that translate Theory to Practices. The content was limited to information that could be found available from 2005 to 2013.

1.8.3 Time Scope

I have limited my content to only existing information that could be found between 2005 and 2013. This is because it is very difficult to obtain data before 2005 since they were destroyed during the war. From 2005 up to now the Ministry of General education through in partnership with development partners have managed to obtain useful data and developed national education plan. This is why the year between 2005 and 2013 are important

1.9 Significant of the Study

The major purpose of this study was to make teaching of practical physics relevant and contribute to the improvement of practical learning. Since education is a responsibility of every one, the following stakeholders will benefit from this study in the following ways.

To the Ministry of General Education and Instruction, the results will form part of policy development by providing recommendations that would point to the need for practical education provision tailored to the learners' needs and societal transformation.

To the development partners, the results will provide a benchmark for strategic partnership with the ministry of general education and instruction by pointing out areas that need collaborative efforts for better practical education in specific and science education in general in the country.

The findings will be beneficial to the teachers in terms of improving the learning teaching strategies of physics practical component. This also follows as a result of positive inputs the results have provided to government and development partners as stated in paragraph one and two above.

The results of this study will directly make students to see what learning should mean to them. Each time they will strive to try something different, something practical and something innovative.

The researchers will find the results of this study important in providing the knowledge in the area of unifying thinking, theory and practice in their research.

1.10 Definition of key terms

- **Physics**: physics is a major science, dealing with the fundamental constituents of the universe, the forces they exert on other and the result they produced. It is simply the study of matter and their interaction.
- **Practical**: practical refers to performing experiment on an actual bit of apparatus and recording the resultant visual indications. In this thesis, 'practical work' means any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials.
- **Practical work:** The term 'practical work' is used in preference to 'laboratory work' because application of practical and location where they are performed are not limited to specific location. The observation or manipulation of objects could take place in a school laboratory, or in an out-of-school setting, such as the student's home or in the field
- **Theory**: Theory is an idealized model of an expert opinion.
- **Thinking**: thinking refers to intellectual capacity to come up with an idealized model that are generally taken to be having intellectual axiom
- **Practice**: practice refers to putting in use what has been learned.
- **Unifying thinking theory and practice**: unifying thinking theory and practice refers to a process that creates the underlying unity that exist between theory, practice and thinking. It is process where great intellectual wisdom becomes an idealized model and the model tested.
- **Practical Learning Essential**: this refers to constituent components that are positive re-enforcement of practical learning. These may include innovative practical curriculum, learning materials aligned with instructional goal, teacher skills and qualifications.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In this chapter, I present background materials tailored to the stated objectives. The aim was to obtain appropriate background information on best practices for teaching practical designed questions in relation to daily phenomenon in life. The background materials covered information on importance of physics experimental component, how learners are prepared for designed practical lesson, and the ''learning essentials'' that promote practical learning.

2.2 Importance of physics experimental component

''...It is my belief that unpicking the Gordian knot that ties science education to its practical base requires, first and foremost, a reconceptualisation of the aims and purpose of science education...'' (Osborne cited in Dallon, 2008, p. 26).

Consenting to the above statement, I decided to find out what literature says about the importance and purposes of practical physics in learners' life. This, according to Wellington cited in Dillon (2008), is very important because education stake holders (teachers, learners and officials) are always surprised, even shocked, when asked to consider what practical is for. The literature has the following views which stand out candidly in favour of practical physics.

Experimental physics enable learners to explain and describe phenomenon (Science Community Representing Education, (SCORE 2008). Personal experience has it that experiment involves personal manipulation of apparatus, observing and recording the resultant visual indications. The two, observation and description, in my opinion, are explicitly intertwined. It is truly possible for a learner to explain and describe fully what is observable to her or him which is best done through experimentation. Therefore experiment exposes the learners to all the practical techniques. This is so in my opinion because learners will observe the effect of the independent on dependent variables and will be interested to find out why the variations.

Physics experimental component makes phenomena more real and less abstract (SCORE, 2008). The view of the SCORE embraces the view of realists stated in the background of this study that problems and concepts presented in the classroom must be similar to those students have encountered, or are likely to encounter, in life beyond the classroom. Like SCORE, Morris (2000) holds that this induces students into the process of scientific enquiry, experimental design and discipline-based research protocols. This, to me, is in vain if the education stake holders are unaware of. To me the resultant effect is overall loss of scientific and vocational talents should there be no attempt to include practicals in teaching and learning physics.

There is evidence that practical work increases students' ownership of their learning and increases their motivation (SCORE, 2008). Equally noted, Wellington cited in Dillon, (2008) argues that practical work is motivating and exciting – it generates interest and enthusiasm. Contrary to Wellington's view, I have the other side of the coin. The view of SCORE and Dillion seems to be more generic. Personally during my school days I never had practical from senior one to senior three but it was my personal interest in physics. Secondly there are groups of people particularly girls who are not moved to physics be that they are given practical or not.

According to Moris (2000), practical designed question promotes a logical and reasoning method of thought. Physics experimental component makes phenomena more real and less abstract (SCORE, 2008). He adds that through experiments, students come to understand that their teacher is not simply a teacher but research is also an important part of his job. From Morris' poin of view we can deduce that experiment is a research by itself and it should be given to learners so that they become potential researchers. I have so far presented some literature on the importance of practical physics. I now move to find out how teachers prepare learners for designed practical questions.

2.3 How teachers prepare learners for design practical lesson

This objective is formulated from the phrase made by Owaifo (2009) that education is a key for national development but it is the teachers who hold the key. Therefore the magnitude of the problem identified for this study demands a qualitative understanding of the pedagogy teachers use while teaching practical physics in their "four wall studio". The literature identifies the following useful experimental pedagogical practices.

Normally theory is tackled in lectures and reading, and practice is tackled in laboratories. Unfortunately, however the links between the two are often unconvincing. This is why this topic is worth a study. According to Dallion (2008), a good physics teacher makes a concerted effort to link theory to practice to win learners' interest through practicals. On the other hand Dr. Brian cited in Dallion (2008) remarked that;

> The worst science teachers make no attempt at all to beautify the curriculum by taking their students out of the classroom and they make minimum effort to run practical classes. Indeed, their sole aim appears to be to cover the curriculum so that their students will achieve the highest grades possible in examinations, even by abandoning many of the practical classes if that should prove necessary'' (Dillon, 2008, p. 10)

Brian's and Dallon's view is an indication that demand for better grades forces teachers and schools to work all day long theorizing physics in favour of practicals even when they are very well aware that practical positions students in the world of work. The description that these are bad teachers and these are good ones is simply a characterization that reflects teachers' pedagogical practices that are practical or solely theoretical.

Dallon (2008) argues that teachers should outline and develop experimental designs during lectures embedded in the relevant theory. According to him, this gives students an opportunity to work in a team environment, apply theory learned in the classroom. This, as we turn to the world of physics, warrants a greater understanding of remarks of the greatest physicist of all time and the founder of relativistic physics, Albert Einstein that; ''...In the matter of physics, the first lessons should contain nothing but what is experimental and interesting to see....a pretty experiment is in itself often more valuable than twenty formulae extracted from our minds...'', (Moszkowski conversations with Einstein, cited in Clinton 2006, p. 67)

Einstein's view puts practical at a common place for teachers and learners. Arguments for this have been provided in chapter two sub section 2.2. However, as noted by Brian and Dallion, this is always overridden by demand for better grades by schools, parents and learners themselves.

According to Dillon (2008), students should be encouraged to design their own experiments or produce reasoned modifications to standard experiments. Divergently and pity, Dillon observed that laboratory works are usually designed by the lecturers. Students then find it difficult thinking through the links between theory and the practical. A study conducted by American Association of Physics Teachers (AAPT) revealed that involving students to design or modify an experiment as advocated by Dillon greatly improved on their ability to design an experiment, apply mathematical procedure to solve an experimental problem, and communicate the details of the procedure (Etkinaa & Murthy, 2006). My experience as a science teacher is that even the teachers do follow the already designed experimental manual. In my view one needs to think of the difficulty involved where a teacher is required to encourage learners to design an experiment yet she or he has not designed one for her or his school. It is a pity.

It is a necessary condition for physics teachers to use some labs as demonstrations of phenomena in order to highlight the need for explanations and theory which will be provided in a subsequent lecture (Dillon, 2008). This statement anchors Pragmatist thought as noted by Brennen (1999) that theory and practice and accepted wisdom should be united. This is critical during preparation. My experience has it that usually theory is tackled in lectures and personal reading, and practice is tackled in labs. Thus the view that some demonstration should be used to support learning theory in the subsequence lesson is a valid argument for promoting practical learning. This brings students to actual reality of life which is the principle aim of realists (Brennen, 1999). In his book titled connecting theory and practice, James[6] (n.d) has this to say in connection to realists' idea,

> We need to move beyond the goal of teaching students a set of skills that is nice to have to teaching a set of competencies that students feel comfortable using on a daily basis. Students should see their skills in a particular subject as tools that are important to use on a daily basis (James n.d).

My experience as a physics teacher is that theory is a deduction from an idealized model. Given the very abstract nature of most physics theories, it is important to discuss them hand in hand with experiment. Grahan & Trevor (2012) like Callahan, Beverly, Chesick, Mandel, Wenning & Mackin, (2009) recommend that some time should be given during and at the end of a lab session to discuss theoretical issues and their implications. Grahan & Trevor further noted that a teacher who helps students understand how physics relates to their lives, the community, and society in general addresses science-technology society issues in a forthright and objective manner. They help students to become informed citizens who will make informed decisions about science related issues as they relate to environmental quality, education, personal and community health. From the literature it can be concluded that there are array of challenges in teaching practical physics. The most critical challenges that present bottleneck to practical physics education is the demand for better grade by schools, parents and students themselves.

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[6] James H. Stith, is the Vice President of the American Institute of Physics and has been named one of the "50 Most Important Blacks in Research Science" for 2004 by the magazines Science Spectrum and US Black Engineer & Information Technology. His article, *connecting theory with Practice was* Retrieved in June 9, 2013, from http://www.maa.org/ql/073-78.pdf *Journal of Science Education, 22(08).*

Keeping in mind the literature on the importance of practical physics and how teachers prepare learners for designed practical questions, I turned to find out what the literature also say about other ''Learning Essentials'' that I consider vital for practical physics education.

2.4 Relevance of ''Learning Essentials'' that Translate Theory to Practices

Under this objective, I essentially tried to look at things that are positive reinforcement to practical learning. These include the place of practical in school curriculum, contents and tools and laboratory facilities and teacher qualifications. Nilsson (2011) describes curriculum as a tool for giving education the legitimacy it deserves. Basing on Nilsson description, I concluded that practical and applicable education is anchored on practical curriculum that gives applicable skills to learners; skills that they will use in solving real world problems in their daily life. First, I start by looking at the place of practicals in curriculum as below.

2.4.1 Practical and its Place in School Curriculum.

Nilsson (2011) defines curriculum as a living document and a tool that gives education the legitimacy it deserves. As a physics teacher, I must say that practical curriculum is a pivotal point for science education. Similarly, promoters of practical curriculum such as Okello (2011) and Dillon (2008) made a concise statement that practical work is a defining feature of school science. Given its due importance, Okello (2011) and Donahoo & Whitney cited in (Semih & Samancıoğlu, 2011) remark that schools cannot hope to improve either the academic achievement of their students or the overall value of their programs without sufficiently integrating it in their curriculum. In this sub-section, the place of practical work in the school curriculum was given explicit re-examination since practical learning is anchored on a well defined living curriculum as stated by Nilsson.

My experience from South Sudan and as a student in Uganda is that students simply follow procedures sequentially laid out in the practical manuals. Tamir and Lunetta cited in

Dillon (2008) asserts that students spent too much time following 'recipes' and, consequently, practicing lower level skills. They add that students eventually fail to perceive the conceptual and procedural understandings that were the teachers' intended goals for the laboratory activities, (Lunetta et al. 2007). Tytler (2007) lamented that prescriptive curriculum prevents innovation.

2.4.2 Laboratory facility and innovation windows

It is obvious in my opinion that practical work is never done in the absence of laboratory or related facilities. It is also obvious that practical is never done unless the experiment is performed on actual bits of apparatus and resultant indications measured. It is also obvious that skill acquisition is a function of presence of school laboratories resourced with necessary equipments. Similarly as earlier cited in the background, paragraph two, Osborne related the centrality of the laboratory to the teaching of physics to be like addicts' relationship to their drug. Pertaining to this study I have a ground to hold a view that presence of school laboratories resourced with necessary equipments unifies theory, practice and thinking while absence of it creates contradictions and complexities in our education system, Okello (2011). So far this is what the literature says about the schools facilities and laboratory. I now turned to look at what the literature says about teachers' skills and qualification in promoting practical physics.

2.4.3 Teachers and qualifications

Uwaifo cited in Uwaifo (2009) argues that education unlocks the door for modernization but it is the teacher who holds the key to the door. In my view, this statement indicates that teachers are axial on which any successful technological and practical educational programme revolves. With technological capabilities, teachers relate to today's, environment and encourage developments in teaching skills as well as helping students make connections with the real world, (Schwarz cited in Davidson, 2000). This calls for professionalization of physics teachers towards methodology that is aligned to teaching practical skills. This is in line with Dewey's view cited in Mustafa (2005) that if we teach today as we taught yesterday, we rob our children of tomorrow. In my view reference to yesterday's teaching methodology is what our education system is. It is theoretical. This is re-enforced by Okello's (2011) view that lack of technical skills and practices among teachers are the ones responsible for this type of education.

According to Scheffler and Logan cited in Mustafa (2005), practical learning involves process in which learners try, fail, access, evaluate, analyze and apply meaningful tasks. This is in line with Mjelde (2006) who asserts that vocational learners learn by trying and failing and trying again. My opinion is that trying and failing require the tools to be in place and orientation of teachers on the use of tools. In the absence of tools and lack of teacher capacity to handle practical issues then trying and failing and trying again deserve not to be talked about. My experience as a science teacher is that practicals loose its purpose if the teacher does not know how to use practical instruments. This in turn translates to student skill gaps in use of practicals which results into low skills and unemployment for youths who have no skills.

There is also a growing awareness that knowledge of the subject taught does not necessarily make a good teacher, even if it remains a fundamental requirement (Claude & Gagnon, 2002). They add that other knowledge such as knowledge of the tools, technologies in use are too required. Since the role of the teacher and the context of teaching have changed, new resources (knowledge, skills, and attitudes) are required to practise the profession. This implies that certification in teaching profession is no longer the sole qualification needed in order to be considered competent to teach (Claude & Gagnon, 2002). Norton & Tom (2008) give views of teachers who incorporate practicals in teaching mathematics.

> students in this project see Maths as having a purpose and have learnt to apply problem solving strategies. They were immersed in the process of practice, learnt lots about suitable materials, managing a project and seeking and transforming information (Norton & Tom, 2008, p. 380).

The above views are indications that linking the learning of a particular subject to the practical aspects makes students see the value in learning that subject, that is, it has a purpose.

Means and Olson, cited in Mustafa, (2005) assert that when students are learning practically using tools, they are in an active role rather than the passive recipient of information transmitted by teachers and textbooks. In my view, whether in-depth or marginal exploration of practical capabilities, teacher competence in practical must not be ignored. This also holds true for (Bünning, 2006) who asserts that at the very centre of quality technical and vocational education and training lies an effective interaction between teachers and learners. Indeed, in my opinion the role of a teacher in building practical skills and scientific capabilities cannot be ignored in physics education.

Uwaifo (2009) holds that the high incidence of school dropout among secondary school students clearly highlights the importance of career development. He adds that these students need practical skills to enable them function profitably in societies. According to him the graduates from existing schools system invariably enter the job market seeking employment that their skill could not handle. To draw the majority of these job seekers out of "unemployment bucket", practical has to become the most potent avenue. This is the reason why practical physics is desired. This again requires training of the teachers that would impact these skills to students.

2.4.4 Content

Reliability of practical in the academia depends on how adequately the experiment has sampled the content materials. My experience as a physics students and teacher is that in all secondary schools that I have attended there is no single practical from the topic such as modern physics. I still vividly remember what happened in Uganda in 2011 when almost all parts of the country were hit by lightening and thousands of lives were claimed yet we teach our students how lightening forms and how to prevent it in electricity and magnetism. In my view therefore if modern physics was tough in more practical form, students would have avoided such untold death by practically installing lightening conductors in their residences.

Another content specific problem is that our school experiments are simply for the purpose of verifying physical lows such as acceleration due to gravity, verifying Snell's law and others. This has very little connection with student daily life. Therefore practical content need to be adequately sampled and be driven to focus on the modern science and technology direction.

2.5 Summary of the literature

The literature explains the importance of practical physics and its applications to learners as they strive to fit in the complex world's time zones. To the teachers, the literature puts practicals at their common place in teaching physics. Verily, it recognizes the importance of teacher's skills and that teaching profession is not only a function of qualification but teacher's competences and skills that in turn get "mirrored" to the learners. Lastly, the place of practical in school curriculum was demanded. If practical found a place in school curriculum, then school laboratories and equipment, practical support learning materials need to be provided for its implementation. Unfortunately none of the literature quoted above directly relate to physics education in South Sudan. This study takes the advantage to explore and add on the existing literature so that the state of practical physics education in South Sudan is put on the front page of practical education community.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

In this chapter, I present research design which gives the view on how the research was conducted, the study population from which accessible population was drawn and the technique used. I also present the methods and tools that were used for data collection and how their reliability and validity were tested. These are followed by the procedures of data collection and how it was finally analyzed, presented and discussed.

3.2 Research design

The study enjoyed the value of descriptive research design to collect and analyze data using qualitative research method. According to Willis cited in Shaila, (2011), qualitative research is a way to understand people by entering into their worlds in order to represent and interpret these worlds. In qualitative research, the researchers try to describe a particular situation in narrative form and analyze data including interview transcripts, field notes, photographs, videotapes, personal documents, memos, and other official records (Bogdan & Biklen, cited in Shaila, 2011). Expressing the value of qualitative research method, Bogdan and Biklen cited in Shaila, (2011) propose that if you want to understand the way people think about their world and how definitions are formed, you need to get close to them, hear them talk and observe them in their day-to-day lives. Since my objectives were to find out the beliefs with which stakeholders define practical physics and its purpose in learners' daily life in the real world, and opinions in how teachers prepare learners for designed practical question, qualitative research methodology was chosen for this study.

3.3 Study population

Study populations were officials from the Ministry of General Education and Instruction and students and physics teachers in selected secondary schools and the university. Another study population was administrators for Strengthening of Mathematics and Science Education in South Sudan (SSEMASESS) program and Africa Education Trust (AET) staff. The students were selected because they are the ones who apply physics to their daily life. I also believed that they were going to express their satisfaction of the practical physics they acquire to solving real world problems. Teachers were selected because they are the ones who connect students with reality in physics. AET and SSEMACESS staff were selected because they are experienced consultants on practical learning of sciences. The staff of the Ministry of General Education and Instruction were selected because they are responsible for initiating policies and assessing the quality of education in the country.

3.4 Sample size

Three categories of respondents were identified with each institution either training students in Physics education or promoting science practicals. These categories were: (i) administrators in the targeted departments in the Ministry of General Education and Instruction (i.e. head of Departments or representative) from whom information about practical issues in physics Education was sought (n=3), AET (n=1) and SSEMACESS administrators (n=3), (ii) teaching staff (secondary schools and university) practicing teaching of physics in those schools or university (n=4), and (iii) students enrolled in the department of physics at university or those doing physics at secondary school levels (n=20). Table 3.1 below shows the summary of the targeted population and the actual population interviewed.

Table 3. 1

Study Population and Sampling Techniques

Study population	Sample technique	Target size	Actual Size	Male	Female
Practicing Physics teachers (secondary and Juba University)	Simple random sampling	4	4	4	0
Students (secondary and Juba University)	Stratification followed by Simple random sampling	20	24	19	5
SSEMACESS Administrators		3	3	2	1
Africa Education Trust		1	1	1	0
Government officials — Deputy Director Teacher Education — Secretary for examination — Director for School Inspection	Purposive	3	5	5	0
Total respondents		31	37	31	6

I have targeted three government officials from MoGE&I as stated in the table 3.1 above. But I later included a deputy director and a senior inspector for secondary schools because they work in the department responsible for secondary education in South Sudan. For the students, I opted for two second year students who were not planned for and two third years student expressed interest to participate in the group discussion and they were co-opted. This accounts for the difference between the target and the actual respondents interviewed.

3.5 Sampling technique

Practicing physics teachers, students and SSEMACESS administrators were selected randomly. Firstly the target respondents were stratified for gender inclusivity and the sample were randomly selected from the strata. I was also interested in a group who are policy makers. These are government officials who are working with MoGE&I. Thus far purposive sampling was used.

According Marczyk, DeMatteo, & Festinger, (2005) purposive sampling enables a researcher to select participants relevant to his or her research question.

3.6 Methods of data collection

Focus group discussion, interviews, observation and documentary analysis were the main techniques used for obtaining data that are presented in chapter four. Description of each method as they were used in this study is given below.

3.6.1 Focus group interviews

Physics as a practical subject cannot wholly be visualized by one person. My research instruments had some questions such as why do we study physics? Can the current teaching and learning practice enable one to achieve the goals of learning physics? [TDR & WHO](1994)[7] asserts that these kind of questions are better answered by focus group interviews. According to Marczyk, DeMatteo, & Festinger, (2005) focus groups is a useful technique for obtaining individuals' impressions and concerns about such questions. This method addressed question one, two and three. The focus group discussions were held with Students in their classroom. The goal of the focus group discussion was to look at the broader context of physics practical, discuss the teaching and its usefulness in our daily life.

3.6.2 Interviews

Kikwahila, (1994) and Natasha, Woodsong, Macqueen, Guest, & Namey, (2005) define interview as a technique designed to elicit a vivid picture of the participant's perspective on the research topic. The interview was focused on all the objectives. All the staff from the targeted development partners, (AET, SSEMACESS), government officials from the Ministry of General Education and Instruction and teachers were consulted using interviews. Bogdan & Biklen, (2007)

[7] Qualitative Research Methods: Teaching Materials from Research in Tropical Diseases (TDR) Workshops, Kikwahila Study Group, page 30.

cited in (Shaila, 2011) defines interviews as purposeful conversations aim at gathering descriptive data in participants' own words that help the researchers to understand participants' perspectives of a situation being investigated. They add that the interviews allow researchers to spend considerable time with participants in their own environments, where they use semi-structured interviews, asking open-ended questions and recording their responses. The open-ended nature of semi-structured interviews allows the respondents to answer from their own context and to freely express their thoughts (Bogdan & Biklen, 2007 cited in Shaila, 2011). I have chosen interview because it is one of the sources of qualitative information and also uses open-ended questions.

3.6.3 Observation

Observation takes place in a natural setting where the participants do not realize that they are being observed (Marczyk, DeMatteo, & Festinger, 2005). According to Hammerley and Atkinson cited in John (2007), observation is a special skill that addresses issues such as the potential deception of people being interviewed. Observation was used because what people say, believe and do is often contradicted by their behaviours (Natasha, et.al. 2005). To take care of this, I used observation to compare and contrast what students do and what they said.

3.6.4 Documentary analysis

Payne and Payne cited in Monageng (2006) describes documentary method as the techniques used to categorise, investigate, interpret and identify the limitations and strength of written documents. They argue that documentary analysis is a very useful research tool for analysing historical progress. They tell us about the aspirations, inventions and intentions of the people at time when we may not have been born (May, 2003). According to Wesley (2010) document analysis shows the authenticity or "truth value" of a researcher. My interest in documentary analysis is to triangulate the respondents' views with the documented evidences in public documents. My interest was mainly on public documents such as South Sudan Development Plan (SSDP, 2011/2013), the General Education Strategic Sector Action Plan, (2012/2017), the South Sudan Secondary School Curriculum (SSSSC 2007) and the Education Information Management System (EMIS, 2011, 2012). I have chosen these documents because they were designed to meet the aspirations of the people of South Sudan.

In this study, documentary analysis has been accorded much recognition right from the genesis of this study and has been intensively used to uncover background materials for this study. This same method was equally used in the proceeding chapters. For this purpose I collected some of the key document from the MoGE&I and Juba University.

3.7 Research instruments

Three interview guides were developed and used for the three categories of respondents. The interview guide for students was focused on obtaining the experience of learners about current learning practices visa-a-vie everyday practice. The interview guide for teachers and development Partners were tailored in such a way that it provided information on how teachers prepare learners for practical physics. They were also constructed in such a way that they provided information on the relevance of the things that are of positive re-enforcement to practical education.

3.7.1 Reliability of research instrument

The instruments were tested at pilot stage twice on respondents similar to targeted. The language used to construct questions under objective two was rather difficult. This resulted in variation in the information provided and the instrument was considered unreliable. The instrument was then reviewed to remove the inconsistency especially on objective two. The latter information obtained by the instrument yielded similar information and I considered it reliable

3.7.2 Validity of research instrument censure

Mentors and fellow students were consulted to evaluate the content of the instrument by objectively comparing question items with what it is supposed to measure. Inappropriate questions were replaced with new ones. Specific research question was sufficiently sampled to ensure validity. Table 3.2 below summarizes the methods and instruments used for data collection.

Table 3. 2

Data Collection Methods and Instruments

Methods of Data Collection	Data Type	Objective	Data collection Instruments	Proof of Reliability	Proof of Validity
Focus Group Discussion	Primary	1, 2 & 3.	Guide	Tested at pilot stage twice on year two university students.	Experienced professionals were consulted. Mentors played the biggest roles
Interviews	primary	1, 2 & 3	Guide		
Observations	Primary and secondary	1, 2	Check list		
Documentary Analysis	Primary and secondary	1, 2 & 3			

3.8 Data collection procedures

First, I met the head of institutions to whom I presented a letter from Kyambogo University introducing me to them as a student of the University intending to conduct a study in their institutions. I also presented to them personal written letter highlighting the topic of the study, the objectives, the purpose and the expected potential benefits to the target group. They then endorsed the letters which granted me the permission to interact with the target respondents in the institution. Prior to collecting data, appointment was first scheduled with the interviewees three days in advance. Interviews was then conducted with the respondents on the times and days agreed upon. Some interviews did not take place on the scheduled day and other dates were fixed for them. During the interviews points were noted and recorded on a voice recorder and note book.

3.9 Data processing, analysis, presentation and discussion

According to Jorgensen cited in Seidel, (1998) data analysis includes breaking up and separating them into manageable pieces and grouping them in themes and sub-themes. I adapted this method because Jorgensen cited in Seidel, (1998) holds that the process enables the researcher to assemble and reconstruct data in a meaningful and comprehensible fashion. First the data from the voice recorder were transcribed and the hand written ones were typed using computer. They were then sorted out according to the emerging themes. In order to generate themes, I repeatedly read the interview transcripts and the field notes. At the same time I read the South Sudan Secondary School Curriculum (SSSSC, 2007) with particular interest to the section on physics in the curriculum, the South Sudan Development Plan (SSDP, 2011/2013) and the General Education Strategic Sector Plan (GESAP, 2012/2017). I triangulated these data sources in order to categorize them on the basis of emergent ideas and themes. From each category, after repeatedly reading all the subthemes, main themes that showed the findings of my study emerged.

At first, I composed all the interview transcripts and all the field notes of observations in Microsoft word files named row data ''source''. The responses of each participant to each interview question was entered in a new table on the same file and given appropriate table headings according to the emerging themes, for example, "participants believe that practical make teaching easy". According to institution, the number of respondents who mentioned such a statement were entered. This resulted in 15 files (presented in chapter four), which were named by the emerging main themes. For example, the first file was named "Perception of meaning of Practical Physics According to Participants". In the analysis section, significant statements were highlighted and analyzed. Eventually a report was written and presented according to the themes that had emerged under each objective and discussed subsequently with relevance literatures.

3.10 Data management and quality assurance

I was responsible for the daily management of the research. On a daily basis, data collection forms were checked for completeness and inconsistencies. Each time new interview guides were collected from the field, a routine checking was done to correct problems with regard to type of subgroup or category of respondents providing the information. In some cases where the respondents were not properly captured, a follow up interviews were made to ensure the accuracy and consistency of the respondents views.

CHAPTER FOUR: DATA PRESENTATION, INTERPRETATION AND ANALYSIS

4.1 Introduction

In this chapter, I present the study findings as they were collected from the field objective by objective. The data presented in the tables below is views of my respondents collected from the various institutions stated in the introductory chapter under geographical scope sub section. The data is a thematic representation of the major issues that had arisen when a particular question demanding answers to a problem was asked. These themes were generated based on the frequency of their appearance. The approach is preferred because it made the data to be presented in a logical, easy to understand format and in original form. Various questions under each objective have been variedly answered by different respondents.

4.2 Experimental physics, its importance

It was my anticipation that the initial knowledge of stakeholders about the importance of practical physics would put my respondents on the frontage of conceptualizing what the study demands before we proceeded. On the other hand, in order to design learning interventions that make practical physics useful in learners' daily life in the real world we have to understand the beliefs with which stakeholders define practical work, their expectations and whether their expectations are being met. For these reasons, the following questions were prepared and the varied responses obtained from the respondents are presented below. To position the respondents with a frame of mind ready for discussion, I started by asking simple questions such as what is practical physics and their views were presented in table 4.1.

Table 4. 1

Perception of Meaning of Practical Physics y Participants

What is practical?							
	Number of respondents by institution						
Response themes	JUBUS	JDSSS	SST	MoG E&I	AET	SSEM CESS	Lecturers JUBU
Translating theory to practice	19	5	0	2	1	3	0
Manual manipulation of apparatus	19	5	0	2	1	3	3
Discovering	19	4	0	0	1	3	0
Demonstrating	19	5	1	3	1	3	3
Experiencing	0	0	0	0	0	3	0
Involving learners	19	0	1	2	1	3	0
Doing something physically	19	5	1	3	1	3	3
putting what is learned in practice	19	5	1	3	1	3	2

Source: Primary data

From table 4.1, 33 respondents view practical as use of physical tools, 34 said putting what is learned in practice. These views concur with the operational definition given in chapter one, sub-section 1.10. Generally, as shown in table 4.1, the results showed that all the education stakeholders have in common a definitive view of what practical is. With this definition in mind, I went on to find out from them what practical physics is meant for. Table 4.2 gives summary of what my respondents believe are the purpose of practical physics.

Table 4. 2

Purpose of Practical Physics According to Participants

What are the purposes of practicals?							
	Number of respondents by institution						
Response themes	JUBUS	JDSS	SST	MoG E&I	AET	SSEM ACESS	Lecturer JUBU
For industrialization	0	0	0	2	1	3	0
To avoid cramming	6	0	0	2	1	3	3
To convince learners that what they learn is useful and promote interest	8	4	0	0	1	3	3
To help learner to apply physics in their life after schools	19	5	1	3	1	3	3
To create positive attitude towards work	0	0	0	0	1	3	0
To provide skills	19	5	1	3	1	3	3
To link theory with practice	19	5	1	2	1	3	0

From table 4.2, only 6 participants said practical physics creates industrialization whereas only 7 said practicals make teaching easy and create positive attitude towards work. Again, only 15 said practical help learners to avoid cramming and help to encourage them to believe that what they learned is indeed useful. However, 32 respondents said practical provide skills to learners and 31 said practical help the learners to bridge theory to practice. These last two statements are significant. They support the rationale why thinking, theory and practice should be a unity other that treating them separately. On the whole the views expressed in table 4.2 agree well with the literature in chapter two sub-section 2.2 on the importance of practical physics. Keeping this in mind, I made a step further on to find from the participants whether the current teaching and learning practices enable learners and institutions to achieve the purposes of practical they mentioned above. Table 4.3 provides some credible answers which established that the current teaching and learning methodologies do not allow learners and institutions to achieve the purpose of practical physics.

Table 4. 3

Views on whether the current teaching and learning methodologies enable institutions and learners achieve the purposes of practical physics

Do the current teaching and learning practice enable you to achieve the purpose of practical you mentioned above?						
	Number of respondents by institution					
Response themes	JUBUS	JDSSS	MoG &EI	AET	SSEM ACESS	Lecturers JUBU
We are achieving some of the purposes. In most of the experiment we do the result confirms to the scientifically proven ones but we are unable to apply it in our daily life.	11	0	0	1	3	0
Only classroom objectives are being achieved but cannot be applied in daily life	19	4	0	0	0	0
We are not really achieving the purposes of practical physics	19	5	3	0	3	3
We are achieving the purpose because we will use it to teach in secondary schools.	7	0	0	0	0	0

Source: Primary Data

From table 4.3, 33 respondents said they are not achieving the purpose of practical physics while 23 students said they are only achieving class room objectives. 3 officials from the MoGE&I also support the students' views. This is a clear evident that the current teaching and learning strategies do not make learners and institutions achieve the purposes of practical physics. We can conclude that this is the problem that has presented itself in a more condensed form in the study background and statement of the problem. Therefore this objective worth exploring and thus it permits this study. Youths' views expressed in GESAP (2012/2017) obtained through documentary analysis pointed to the current teaching and learning strategies as;

> Youth consultations conducted as part of the strategy development indicated that the current education system is not practical and is not geared towards the labour market. The youth consultations identified a huge demand for education and training, but also recognized the lack of schools and qualified teachers to meet this demand (GESAP, 2012/2017, p.20)

Therefore the finding from documentary analysis agrees with the views obtained from focus group discussion and interview. The education system has therefore left out the fundamental component of physics, practicals, which would be of advantage to the youths.

Having known that the current teaching and learning strategies cannot allow students and institutions to achieve the desired purposes of practical physics, I moved to explore, in the context of South Sudan the reasons a physicist or educator may use to explain this. The opinions expressed by participants in table 4.4 point out some of the cardinal stumbling blocks to the progress and expected expanding scope of practical physics.

Table 4. 4

Barriers that hinder the progress of practical physics

What are the barriers that hinder the progress of practical in secondary schools and universities?						
	Number of respondents by institution					
Response themes	JUBUS	JDSSS	MoG &EI	AET	SSEM ACESS	Lecturers JUBU
Lack of laboratories in secondary schools	19	5	5	1	1	3
Lack of practical physics skills among teachers/lecturers	19	5	5	1	3	2
Loose relationship between theory and practice and their application in daily life. Teachers give knowledge just like a bank and there is no relationship between what they teach and what happen outside classroom	19	5	3	1	3	1
Absence of national policy on science	0	0	1	1	0	0
Lack of finance for practical physics projects	0	0	5	1	3	2
Language problem among teachers	0	0	3	0	3	0

In table 4.4, 34 participants attributed barriers to practical physics to lack of school laboratory, 32 attributed it to lack of practical skills among teachers and loose relationship between theory and practice and their application in daily life. However, 2 participants, 11 participants and 6 participants associated major hindrances to practicals as absence of national science policy, lack of finance and language barriers among teachers did not bring out a strong correlation as major contributing factors downplaying the progress of practical physics. On the whole, the results explain that the poor process in preparing learners for practical physics is a result of combination of factors and cannot be blamed solely on teachers.

Contented that the above are the barriers to practical physics, I explored the avenue a physicist or an educator may use to make practical physics meet its purposes and improve the scope of its quality in secondary schools and universities. In table 4.5, the participants provided some credible suggestions for improvement of practical physics

Table 4. 5

Ways of Addressing and Improving Quality of Practical Physics in Schools

How may the above issues be addressed in order to improve the quality and scope of practical physics in schools?						
Response themes	JUBUS	JDSS S	MoG E&I	AET	SSEMA CESS	Lecturers JUBU
Employ Laboratory technicians in schools	19	0	0	0	0	2
Trained teacher skills of practical physics	19	5	5	1	3	3
Start practical right from sec. Schools	19	5	5	1	0	3
Start practical right from primary Schools	0	0	0	1	3	0
Provide Laboratory tools and facilities	19	5	3	1	3	2
Practical be taught in line of what can be applied outside classroom	19	5	3	1	3	3
Encourage field work to industries	7	0	0	1	0	0
Create awareness to break the barriers to practical physics	11	0	5	1	3	0
Develop skill based curriculum that promotes teaching of practical subjects	11	0	1	1	0	0
Recruit more science teachers.	11	0	2	1	3	0
provide more fund for practical physics	19	0	5	1	3	2

From table 4.5, 36 participants believe that the problems in table 4.4 may be minimized by training teachers and lecturers on practical physics skills while on average, 34 participants said the barriers may be solved by teaching physics skills that is applicable outside classroom, teaching practical alongside theory, building a base of practical in secondary schools, providing laboratory facilities and equipment and allocating some fund for practical physics. However, a very small proportion of 8 participants suggested encouraging practical exams and field visits as solutions. On the whole, the responses provided probable inputs to the objective and for improving scope of practical physics in schools. The respondents did not however explicitly explain how practicals may be made applicable outside school life. So I invited them again to give their views on how practicals may be made applicable to students' daily life. Table 4.6 point specifically to the aspects relating to how practical physics may be made applicable in students' daily life in the real world outside their school life.

Table 4. 6

Making Physics applicable to students' daily life in the real world

How can physics be made applicable to students' daily life in the real world?						
Major these	JUBUS	JDSSS	MoG &EI	AET	SSEMA CESS	Lecturer JUBU
Relate Teaching and learning to daily life and the environment around us. It is when what is taught theoretically is also done practically.	19	5	3	1	3	2
They should teach things that are relevant to the current needs and make us self employed.	16	5	3	1	3	3
Relate learning to industrial activities	19	0	0	1	0	2
Accompany learning with field visit for students to see the actual reality.	19	0	0	0	0	2
Encourage students to design experiments	19	5	2	1	3	2
Improvise locally available materials for teaching and learning practical physics where readymade material may not be available	0	5	0	1	3	0
Encourage learning by doing.	19	5	5	1	3	1
Promote learning through technical and vocational schools.	11	0	2	1	0	2

Source: Primary data

From table 4.6, 33 respondents proposed teaching and learning method that relate to daily life and environment around the learners. 31 advocated for teaching contents that are relevant to the current needs while 32 encourage learners to participate in designing their own experiment and test them. Although quite above average, only 22 said that teaching and learning should relate to industrial activities and 21 preferred accompanying learning with field visits for students to see the actual reality. These two approaches are too importance. Generally speaking, the results aligned well with the general statement in the background that teaching and learning should relate to what the learners have and will experience in life beyond school life (Brunnen, 1999).

So far I have interpreted the results on the purpose of practical physics. I now reflect to analyze and interpret the results on vocational practices teachers employ while preparing learners for designed practical questions.

4.3 How teacher prepare learners for design practical questions

This objective is formulated from the fact that education is a key for national development but it is the teacher who holds the key (Uwaifo, 2009). Any nation that wants to transform from a knowledge based society to technology based society must come to the teachers. Hence, some leading questions were prepared to find out how teachers are preparing learners for designed practical questions. To these questions, my respondents gave diverse opinions on the existing practical learning practices by the key holders. The views cover the practices generally in South Sudan and the institutions I visited in particular. I started by asking my respondents' views on how teachers prepare learners for designed practical question. Their views as obtained through interviews and focus group discussion are as presented in table 4.7.

Table 4. 7

How teachers prepare learners for practical physics

From your observation as students, teacher trainer in practical education, explain briefly how teachers prepare learners for practical lesson in physics?						
	Number of respondents by institution					
Response themes	JUBUS	JDSSS	MoG &EI	AET	SSEMA CESS	Lecturers JUBU
Explain theory and methodology, demonstrate and leave learners to do the practical.	19	0	0	1	3	3
There is no practical in secondary. Teaching is theoretical	19	5	3	1	3	3
Introduce students to laboratory tools to be used	19	0	0	0	0	3
Provide Guidance to students in the process of carryout the experiments.	14	0	0	0	0	3

Source: Primary Data

From table 4.7, 25 participants reported that during practicals, teachers explain the theory, methodology, carry out demonstration and leave learners to do the practical. 22 respondents said teachers introduce students to the laboratory equipment to be used. A critical analysis of the data showed that the above statistics correspond to data from University where some experiment is carried out to some extent. Conversely, 34 respondents asserted that there is no practical in secondary. Teaching is done theoretically. This explains the reason why students fail to apply physics in their daily life and also why some students were calling protractor as angle and thermometer as temperature as stated in the background and the problem statement.

Having established the norms of how teachers prepare the learners for practical, I moved another step ahead to establish the appropriateness of the practices for giving skills that learners will use in their daily lives. Table 4.8 gives the views of the respondents as they evaluate the appropriateness of the approaches. However, because of the complex nature of data and the qualitative relevance of the reasons given, I decided to leave the data in its original form.

Table 4. 8

Perception of the appropriateness of the learning methodologies used by teachers

Year three JUBUS	We don't think the methodology is appropriate because we do not apply what we learn in our daily life.
Year three JDSSS	The methodology is not good because I see a lot of difference between what they teach and the reality. For example one day a teacher taught us about flowering plants but when I went and pick up a flower I see different things from what the teacher told us.
Year two JUBUS teachers	Teachers are using inappropriate methodology. That is why practical subjects are not interesting learners. It only prepares us to pass examinations.
Head of department-physics	Our methodology is the methodology for teaching ''sciences''. It is not applied ''science''. So students always find it difficult to apply what they learn and therefore see it as inappropriate.
Lecturers and lab technician-JUBU	Most of the university in Africa and may be with us here we spent a lot of time teaching theory. In fact we are theoreticians.
Director for Inspection	First of all in secondary schools teaching is theoretical. Student can't see what they are supposed to practice on. This method is not good for practical.
Coordinator AET	Teachers give knowledge to students just like bank and there is no relationship between a teacher teaching and what is happening outside a classroom. So the method of teaching is not appropriate.
SSEMACESS staff	We had this teacher centered where the teacher just come and talk. The learner will not reflect on what was learned as the other teacher is entering.

Source: Primary data

From table 4.8, all the respondents reported that the methodology of teaching practical physics is inappropriate. For example, Juba University students said "...we do not think the methodologies are appropriate because we do not apply what we learned in our daily life...". This calls for a revised teaching and learning practices that make practical physics meaningful and relevant to the learners. Since stake holders must form a core of any education initiative, I decended to find out from the respondents the methodologies they think are appropriate for teaching practical physics. Their views as obtained through focus group discussion and interviews were presented in table 4.9.

Table 4. 9

Suggested methodologies for teaching practical physics

In your opinion what methodology would you/your Organization wish to see teachers use in teaching designed practical sciences so that it is related to everyday life and applicable?							
	Number of respondents by institution						
Response themes	JUBUS	JDSSS	MoGE &I	AET	SSEMA CESS	SST	Lecturers JUBU
Demonstration	19	5	3	1	1	1	3
Field learning	19	0	3	1	0	0	0
Group learning	19	5	3	1	1	1	2
Experiencing learning/child centered learning	19	0	3	1	1	1	2
project learning	0	0	0	0	0	0	2
Discovery Learning	0	0	3	1	3	1	2

Source: primary data

From table 4.9, 33 participants said demonstration and group learning are good approaches to practical learning. 25 view experiencing learning or child cantered learning as the best approaches in practical learning. In contrast, a small proportion of only 2 respondents mentioned project learning as appropriate method for practical whereas 10 respondents mentioned discovery learning as appropriate methods yet the later two play important role in experimental physics.

Perhaps the physical significance in the variation is the understanding of the terminologies and how they are applied in practical learning.

The results in table 4.9 and the demand for practical application in students' daily life motivated me to find out whether education stakeholders encourage learners to design their own experiment. My aim was to find out if teachers do encourage learners to design their own practicals. When asked, learners, government officials and developments partners had this to say and the data were left in their original form in table 4.10 because of their qualitative relevance and significance

Table 4. 10

Perception of whether stakeholders encourage teachers to make learners design their practical

JUBUS	The department has a prescribed list of experiment to be done in a particular semester. So we do not do any practical of our own. lab regulation does not allow us to carry out practical in the lab outside the experiment that they have
JDSSS	Teachers do not give us practical and they do not encourage us. Sometime we try out things on our own to see whether what the teacher taught is true. I pick a flower to see if what the teacher was talking about is true. But I found out that it was not the same
SST	First of all these students are not introduced to practical. Some teachers even fear to carry out experiments for the reason that they would be embarrassed before the students should the experiment fail to work. So at the moment most teachers are not encouraging learners to design their own practical.
Lecturers JUBU	They can design their own experiment but here in University of Juba we do not have project magazine. We do not have circuit builders and other practical components. So it is difficult for our student to design their own experiment. We do not have fund.
MOGEI	We do encourage teachers to allow students to do practical themselves. Our policy requires that all science subjects be taught practically. But because these ''things'' are not yet there teachers cannot encourage the learners to develop their own practical. We are trying to encourage them through SSEMASESS program.
AET	Actually we trained teachers. We taught even students to do their own practice for example they are able to improvise single fixed pulley and other types of pulleys
SSEMASESS	In our teacher training, we advised teachers to encourage learners to design practicals

Source: primary data

From table 4.10, all the development partners said that their training principle is to train teachers so as to make the learners design practicals by themselves. Officials from MoGE&I and students reported that teachers are not encouraging their learners to design practicals on their own. Students are therefore not exposed to a laboratory environment that could help them transit from performing pre-packaged experiments to more independent self made ones. This does not develop the creative arts of the brain (thinking) as they simply wait to do an experiment already prepared by their teacher. This also means that teaching in secondary schools is theory-based which cannot predict performance nor describe an overall positive effect on practical learning as it is being taken in isolation (see figure 1.1, the theoretical framework). Accepting that teachers are not encouraging learners to deign practical, I decided to seek the respondents' opinions that can be used to explain such a predicament and the respondents' views are presented in table 4.11.

Table 4. 11

Views of the factors hindering teaching of practical physics

What are the factors hindering teaching of practical physics?						
Response themes	JUBUS	JDSSS	MoG E&I	AET	SSEM CESS	Lecturers JUBU
Variation in teacher qualification. A primary four dropout out may be found teaching primary eight even secondary in some states	0	0	5	1	3	0
Absence of Unified curriculum and existence of foreign curricula.	0	0	5	1	3	0
Absence of and poorly equipped school laboratory	19	5	5	1	3	0
Lack of practical skills among teachers	19	5	5	1	3	2
Lack of training opportunity for teachers on methodologies for practical sciences.	0	0	3	1		
Resentment to the new teaching approach by learners	0	0	0	1	0	0

Source: primary data

From table 4.11, 35 of the respondents believed that lack of practical skills among teachers and absence of and poorly equipped school laboratories are the ones that demotivate teachers to encourage learners to design practical on their own. Although only 9 respondents mentioned variation in teacher qualification, there is strong evidence in GESAP (2012/2017) obtained through documentary analysis that supports the opinion. For example, according to GESAP (2012/2017, p. 20), ''...a primary four dropout out may be found teaching primary eight even secondary in some States...''. Again 9 respondents voiced their argument that it is lack of unified curriculum (some are theoretical) and existence of foreign curricula that impede the teaching of practical physics. A critical analysis of the results in the table shows that those who accredited challenges facing teaching to curriculum in teaching practical physics are government officials and development partners. This means that curriculum and teacher education are policy issues well known by government officials and development partners.

Only 1 participant reported that sometimes learners reject new approaches of teaching and learning practicals. On resentment to the new approaches to teaching and learning practical physics, AET has this to explain.

> There is a challenge in introducing new methodology of teaching. Students look at this kind of methodologies for instance, student cantered approach and end up saying this teacher does not know how to teach...this teacher knows nothing...why does he wants us to be doing everything all the time...they consider him the worst teacher when they compare him with another teacher who comes and talks the whole lesson, give some notes and goes away,(interview with AET coordinator, Jan 2013).

The AET view clearly shows that many learners are used to traditional method of teaching where they take the prescribed period in school, receive passing grade and graduate without practical skills. This is why objective one becomes very important in this study because it explains and raises awareness about practical physics not only to the learners but to all education stakeholders.

To this extend, I have presented, interpreted, and analyzed data on the importance of practical physics and how learners are being prepared for designed practical physics. Another variable that I looked forward to present, interpret and analyze is the ''learning essentials'' that I consider are positive re-enforcement of practical learning.

4.4 Relevance of the "learning essentials" that translate theory to practices

Under this objective, I essentially look at curriculum, contents, tools and laboratory facilities. Curriculum is a tool that gives education the legitimacy it deserves (Nilsson, 2011). Therefore, practical and applicable education is anchored on practical curriculum that gives applicable skills to learners; skills that they will use in solving real world problem in their daily life. To obtain views on the state of affairs of those learning essentials, I coined some questions that yielded convincing views from my respondents. I started by finding the views of my respondents about the strengths and weakness of the curricula operating in South Sudan and their views are summarized in table 4.12.

Table 4. 12

Strengths and weaknesses of curriculum in promoting practical physics

Discuss the strengths and weaknesses of curriculum, laboratory facilities in promoting physics practical in South Sudan

		Number of respondents by institution					
	Response themes	JUBUS	JDSSS	MoG &EI	AET	SSEM ACESS	Lecturers JUBU
Strengths	The curriculum enables learners to pursue masters degree even outside South Sudan	19	0	0	0	0	0
	The secondary school curriculum does not only cover theory but also has some aspects of practicals.	0	0	0	1	0	0
Weaknesses	Curriculum is overloaded with many unpractical things.	19	5	0	0	0	
	The implementers of the curriculum implement only the theory	19	5	3	1	3	2
	secondary schools curriculum lacks text books for it implementation	0	0	2	1	0	0

Source: Primary data

From table 4.12, 19 university students asserted that the curriculum they are following can enable them to study for masters even outside the country. Only 1 participant acknowledged that South Sudan secondary School Curriculum (SSSSC) strikes a good balance between theory and practicals. Through documentary analysis, I found out that SSSSC provides sequence of course, laid out list of practical tools and materials and points out method of delivery to be used in specific areas (SSSSC, 2007). This confirmed the view of the participants. However, the designed curriculum was found to be having implementation challenges. For instance 33 participants revealed that the curriculum lacks text books and necessity laboratory equipment for implementing it. On the limited number of text books, AET remarks that;

> There are no textbooks for this curriculum in secondary schools. So I don't know what teachers use to implement the curriculum. If you go to the secondary schools they are still using old books. Sometimes they struggle to get information from the text books which are irrelevant to the curriculum (interview with AET, Jan, 2013).

Still, through documentary analysis, it was found that Juba University curriculum outlines list of practicals to be covered in a particular semester (Juba University physics curriculum, 2011). It also has aims and objectives. The curriculum on the other hand does not provide the methods for delivering practical lessons and did not define the tools and materials that may be used for teaching practical physics. It can therefore be concluded that tools is one of the factors that contribute to poor preparation of learner during practical lesson as noted in table 4.4.

Table 4. 13

Strengths and weaknesses of laboratory facilities in promoting physics practicals

Discuss the strengths and weaknesses of laboratory facilities in promoting practical physics							
		Number of respondents by institution					
	Response themes	JUBUS	JDSSS	MoG &EI	AET	SSEM ACESS	Lecturers JUBU
Strengths		0	0	0	0	0	0
Weaknesses	Laboratory tools used in Juba University are old	19	5	0	0	0	
	Laboratory itself is old	19	5	3	1	3	2
	There are no laboratory and lab equipments in secondary schools	19	5	5	1	0	3

Source: primary data

It can be seen from table 4.13 that none of the participants commented on the strengths of the laboratory tools and equipments. But through observation, I established that there are opportunities for the schools and Universities. For example, in secondary schools I visited, I observed lab equipments which through interview, an official from the department of secondary education revealed that they were provided by the MoGE&I. The unfortunate part is that these tools are observed being kept in store and are not open for use to the learners. Two cardinal arguments are used to explain this. First the school is following the theoretical Sudan school curriculum and there was no need to teach practicals. Secondly, there is lack of trained teachers to teach practicals in the schools. Similarly, in Juba University new practical tools and instruments were observed. It was reported that they were provided by Norwegian Government but some are not being used for similar reason of lack of skilled staff. The opportunity here is that government is committed to providing laboratory tools to secondary schools and Universities.

Having known the strengths and weaknesses of the curricula, teachers, tools and materials, I bent to explore specifically the relevance of the curricula in question in the context of South Sudan. Although there was no set standard for this specific question, the following views of the respondents on the relevance of the curricula documented in table 4.14 are used as a yard stick to measure the relevance of the curricula.

Table 4. 14

Relevance of Curricula in South Sudan

In your opinions do you think the curriculum you are taking is relevance in giving the required practical physics						
Response themes	JUBS	JDSSS	MoG &EI	AET	SSMA CESS	Lecturers JUBU
The curriculum is full of unpractical things (Sudan curriculum)	16	5	5	0	0	2
The curriculum has a balance of practical and theory (South Sudan curriculum, 2007)	17	0	5	1	3	1
The curriculum does not give the required skills (University curriculum)	19	5	2	0	0	0

Source: primary data

From table 4.14, 28 participants reported that the Sudan curriculum is unpractical. This is because curriculum content is theory based. On the other hand, 27 applauded the South Sudan curriculum saying it strikes good balance between theory and practice. Contrary to this view the curriculum is being implemented theoretically. The reasons for this were given in table 4.12 where I analyzed the strengths and weaknesses of the curricula. For these reasons it was stated in the curriculum that (GESAP, 2012) there will be no examination on practical physics but some questions will be set to test candidate's evidence of such experience. According to SSSC, 2017 the major reason for implementing the curriculum theoretically is because not all secondary schools have received laboratory equipments and in addition, there are no or few teachers who can teach practical physics in those schools. At this point, with the above perspectives in mind, I decided to examine from the participants what changes they recommend to improve the practicality of South Sudan curriculum. Their views are presented in table 4.15.

Table 4. 15

Suggested changes to improve the practicality of South Sudan curriculum

What changes do you recommend to improve the practicality of South Sudan Curriculum?						
Response themes	JUBUS	JDSSS	MoGEI	AET	SSEMACESS	Lecturer JUBU
Develop learning materials and provide all the necessary tools to implement the curriculum.	19	0	4	1	3	2
Train teachers on practical skills so that they demonstrate practically to students	19	5	3	1	3	2
Design curriculum that meets society need	19	0	4	1	3	0
Involve University lecturers, teachers and employers in the design and development of the curriculum.	11	0	3	1	0	0
Introduce practical examinations in secondary schools	0	0	3	0	0	0
Unify the curriculum across the country to get rid of theoretical and foreign curricula.	0	0	5	1	3	0

Source: Primary data

From table 4.15, 33 proposed training teachers on practical physics skills that they will use to implement the South Sudan secondary school curriculum practically. A text from GESAP, (2012/2017) obtained through documentary analysis documented this in need for trained teachers. ''...to build a high quality education system, the MoG&I needs to have a qualified teaching workforce that teaches relevant and inclusive curricula to learners, using high quality learning and support materials...'', (GESAP, 2012/2017, p. 41).

On the other hand, 27 respondents advocated for development of curriculum that meets the need and aspirations of society. This concurred with the view stated in South Sudan Development Plan (SSDP, 2012/2017) got through documentary analysis. The plan proposed review of curricula for primary, secondary and technical schools.

Small proportion of the respondents called for unification of South Sudan curriculum and introduction of practical exams in secondary schools. The difference in opinion here is that most respondents do not see practical exams as necessary since practicals are not being taught in all the secondary schools. However, the agenda for unification of the curriculum has appeared in several education meetings and workshops in South Sudan.

In general, the opinions expressed in the table 4.15 give directives that account for problems hindering the progress of skill-based curriculum. It also expands the scope of the problem to include curriculum and support learning materials that are lacking.

4.5 Summary of findings

Results disclosed that there is a marked awareness amongst students, teachers, government officials and development partners about the importance and purpose of practical physics and its application in everyday life and in bringing about societal transformation in a correct mode. Results also showed that teaching of practical physics has taken up a methodology deeply rooted in theoretical dimension. Lack of laboratory facilities, trained teachers, inappropriate teaching methodologies, underfunding and lack of science policy were found to be responsible for this. The results further indicate that all these combined together do not allow institutions and schools to realized the purposes of practical physics.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

In this chapter, the results presented in chapter four are again presented in a snapshot form and subsequently analyzed and discussed. This chapter is a point of convergence where the literature used, various opinions expressed and arguments collected using different methods are compared and contrasted following the objectives. The findings for this study were also compared with the findings of other studies conducted on the similar problem elsewhere. The underpinning aim was to have a reflective thinking on the margin that exists between the ideal and the real physics educational practices that relay on the ''theoretical tradition of hospitality'' documented in chapter four. It is this theoretical ''tradition of hospitality'' that creates impossible odds in our education system. In this chapter, from a standpoint of the problem under investigation, I qualitatively discussed the results against experiences and background materials.

5.2 Physics practical and its Importance

It was my anticipation that the initial knowledge of stakeholders about the importance of practical physics would put them on the frontage of conceptualizing what the study demands before we proceeded. On the other hand, in order to design learning interventions that make practical physics useful in learners' daily life in the real world there was need to understand the beliefs with which stakeholders define practical work, their expectations and whether their expectations are being met. The results for this particular objective were presented, interpreted and analyzed in chapter four sub sections 4.2. Below in the discussion, I only supplement it with my experiences as a teacher and student of physics.

It was established in table 4.1 chapter four that the purpose of practical is to give skills that learners will use in their daily life. 36 respondents believed that practical is an application of science leading a learner to use what was learned to support him or herself. A similar result was arrived at by Wooly (2009) who found out that effective practical work can develop important skills in understanding the process of scientific investigation. It is also in line with (Ngozi & Norman, 2006) notion that practicals offer students opportunities to develop problem solving skills that can be seen not only in terms of applying knowledge in a routine way but also in highly open-ended situations where physics ideas relate to life situations and decision taking. The above views underscore the purpose of practical physics. Conversely, in the prevailing situation, basing on the opinions expressed in chapter four, achieving such higher order purpose of practical education is infinitely a long journey to take (reasons provided in table 4.3, 4.4, 4.7 4.8, 4.11, 4.12, 4.13)

My study also instituted that participant thought practical work was helpful for increasing students' interest in learning physics theories and concepts. 16 participants confidently stated that when teachers take students through practical activities, or when the students do practical activities by themselves, they become more interested in learning physics concepts. Stokking (2000) conducted study on children attitudes on physics and found that the main predictor of the choice of physics in secondary school is its future and practical relevance. Accordingly, some recent work cited in (Ngozi & Norman, 2006) revealed that, when physics is made inaccessible to school students they tend to resort to memorization to pass examinations and this in itself, generate negative interest towards physics. This finding is in agreement with SCORE (2008) and Wellington cited in Dillon (2008) who found out that practical work increases students' ownership of their learning and increases their motivation and excitement. Chiaverina & Vollmer (2005) express a similar view. This confirms the nexus of our great physicists, Albert Einstein cited (Clinton, 2006) that;

> In the matter of physics, the first lessons should contain nothing but what is experimental and interesting to see. A pretty experiment is in itself often more valuable than twenty formulae extracted from our minds'', A. Moszkowski, Conversations with Einstein, Horizon Press (1970, P. 67)

Although the numbers of respondents were less than half of the total respondents, I as a practical physics teacher agree that practical promote learning interest.

35 participants thought that practical work makes teaching and learning of physics easier. Participants believed that when teachers teach using practical work, students understand more easily; and when they teach without any practical work, it takes a longer time to help students understand the concepts of physics. According to them, when teachers explain the concepts by doing practical activities, and when students can also do practical activities, students can observe how things happen and grasp the underlying concepts. This view is related to those of Millar and Abrahams cited in (Shaila, 2011) that learning science must involve observing, managing and operating real objects and teaching science should include demonstration.

It was established that practicals enable learners to see relationship between theory and practice. 34 respondents in table 4.2 including all the students assertively said practicals connect them to the real world. According to Stanford Encyclopedia of Philosophy [SEP][8], experiments test theories and provide the basis for scientific knowledge. It can also call for a new theory, either by showing that an accepted theory is incorrect, or by exhibiting a new phenomenon that is in need of explanation. All the Secondary school students reported that since they were not being taught practicals in their schools, they try to find out on their own what the teacher teaches and what is the reality. On state of discontinuity between theory and practices one of the students expresses his dissatisfaction as;

[8] Experiment in Physics. Taken from http://plato.stanford.edu/entries/physics-experiment/.*First published Mon Oct 5, 1998; substantive revision Tue Jun 19, 2012*

> I see a lot of difference between what they teach and the reality. For example one day a teacher taught us about flowering plans but when I went and pick up a flower I saw different things from what the teacher told us. I wish they teach us practically (view of one of JDSSS from a group discussion, Jan, 2013).

This mixed feeling would have been corrected or avoided if the teacher had brought a flower in the classroom during the learning process. It is not surprising that such a student fails to see meaning in learning and eventually loses interest as stated in paragraph two above on the account that what was learnt in the classroom was not similar and anywhere closer to what they find outside. This confirms the importance of realism theory of education on which this study is grounded (Brennen, 1999). Realist holds that problems and concepts presented in the classroom must be similar to those students have encountered, or are likely to encounter. This, in the absence of practical remains a nightmare in the life of students.

Interestingly, the results ascertained that practicals induce positive attitude towards work but only 4 participants presented this idea. To me this view seems to have emerged from two important areas; from the view of Technical, Vocational Education and Training (TVET) and from the view of entrepreneurship. From TVET point of view, the view confirms to that of (Woodley, 2009) cited in (Shaila, 2011) that effective practical activities build a bridge between ''hands-on'' and ''minds-on'' activities. Looking at practical from an entrepreneurship point of view I can assertively say that we are moving towards entrepreneurship, creating for ourselves jobs and science is much more of practice than theory because anything that you learn in science is what is normally put in practice. So practical provides students with hand-on skills and even ability to put what they learnt in practice and eventually students can become entrepreneurs.

My own understanding of all these concepts is that practical is work or a preparation towards work. The only question I may ask is that what practical skills should our learners attain in order to be considered work ready? My answer to my question is that skills equivalent to employable one, working skills! However, the results indicate that this particular purpose of practical is hard to achieve (reasons are given in challenges subsection).

The study also established that practicals help learners to remember and reflect on what they learn thereby avoiding cramming. SEP supports this on the account that experiment provides hints toward the structure or mathematical form of a theory and it can provide evident for the existence of the entities involved in theories. 15 participants in table 4.2 valued practical work in teaching and learning physics. They were aware that practical work is essentially related to developing conceptual knowledge of physics, which according to Woodley (2009), it corresponds to the perceptions of most United Kingdom science teachers. According to the report presented by SCORE cited in Woodley (2009), teacher demonstrations are considered as the core activities in practical work because it directly relates activities and laboratory procedures and techniques. 32 participants in table 4.5 proposed that after theoretically teaching any conceptual knowledge of physics, teachers should provide students with related practical activities to reinforce the ideas.

5.3 How teacher prepares learners for design practical questions

I have repeatedly quoted literature throughout all the sections of this thesis that education is a key for development but it is the teacher who holds the key. Under this objective I discussed how the key holder with her or his apparatus in her or his ''four wall studio'' prepares learners for practical in South Sudan. My assumption is that no one has a capacity to teach practical physics. The action is in the classroom. Only the teacher can do it. Physics cannot be ''canned'' from a ''teacher proof text" book or curriculum materials.

In table 4.7, the results made known that students in South Sudan secondary schools learn the concepts of physics through rote memorisation, where teachers transfer the knowledge of physics to the students using lecture methods, filling them up with facts, concepts, and laws.

Hence, there is no preparation for practical in secondary schools as teaching is done theoretically including even subjects that should have been taught practically like physics. This confirmed my experience stated in the background in sub-section 1.1 paragraph 7 when some of my students were calling thermometer as temperature and protractor as angle. Indeed, to me, the students were not wrong. They were not simply introduced to the culture of practical right from secondary. This also confirmed to Okello (2011) who asserts that most teachers talk about technology and practicals but do not teach technology and practicals.

According to Okello (2011), rebirth of practical education requires a greater understanding of the fifth century Chinese philosopher by the name of Lao-tse (also called Lao-tzu) on whose views the early study of the philosophy of education oscillated. Cited in Okello 2011) Lao-tse had this philosophical assertion during his life time; ''...If you tell me, I will listen. If you show me, I will see. But if you let me experience, I will learn...''

It is my honest deduction that most teachers in South Sudan are at the stage of telling yet and that is lecture or chalks and talk, or teacher centered method. Many cannot show just like the teacher who was teaching the flowering plant could not bring in flower to the class or take learners to the flower. Stage three which is letting the learner learn by doing is regrettably absence. The proverb educates us on the importance of practicals. Similarly, (Chiaverina[9] & Vollmer[10], 2005[11]) assert that just as in scientific research, the experiment retains a central role, and is indeed indispensable in the teaching of physics, regardless of the degree of rigor.

As ealier stated in the Literature in chapter two paragraph 2.3, Dillon (2008) asserts that students should be encouraged by teachers to design their own experiments or produce reasoned

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[11] This work is based on results from a discussion workshop during the 2005 GIREP seminar in Ljubljana with about 20 participants from around a dozen different countries.

modifications to standard experiments. Chiaverina & Vollmer (2005) explain the imprtance of having learner to design for themselves their own experiments by modifying the Chinese proveb to include the use of self-build apparatus as; ''...I hear and I forget. I see and I remember. I do and I understand. I do with self-build apparatus and I never forget...''

The view expressed by Chiaverina & Vollmer, seem to indicate that there is a tendancy to forget what is experimented on someone apparatus than on self-made apparatus. I think the reason is that students know for what purpose they desinged their experiments. I also belive that they will think of how to improve their experiments as new ideas come into thir mind and as they grow.

However, in table 4.10 the results from group discussion and interview established that students are not encouraged to design their own practical. When asked why they are not designing their own experiment, year three university students had this to say;

> The department has a prescribed list of experiments to be done in a particular semester. We simply do any practical they give us. So we are not encouraged to do any practical of our own. Besides, the time table is fixed. We do not have any other time to do our own experiments or project works. (Year three University Students, Juba University, Jan 2013)

There are many reasons advanced to explain why teachers are not encouraging learners to design their own practical (see result section, table 4.10). One appealing reason is that teachers themselves lack practical skills. One of the secondary school teachers explains;

> Some teachers even fear to carry out experiments for the reason that they would be embarrassed before the students should the experiment fail to work. At the moment most teachers are not encouraging learners to design their own practical. (Interview with a secondary school teacher, Jan 2013).

Believing that the teacher is the key holder, it is hard for one to expect students to deign their own experiment if a teacher has never designed one. I possed this question earlier in the literature, chapter 2, sub section 2.3 parahraph 3 leaving the reader to think of the difficulty involved where a teacher is required to encourage learners to design an experiment yet she or he has not design one for his or her school.

In table 4.10 and 4.11, the results established that there are predominantly two methods of teaching and learning physics. In secondary schools, physics is taught theoretically whereas the University inclines to demonstration to some extent as the best method of teaching practical physics. In table 4.7, result through focus group discussion and interview with students and University lecturers at the department of physics including the head of department indicate that in the preparation process, lecturers identify the apparatus to be used for specific practical, carry out demonstration and allow students to do the experiment. Lecturers from the department of Physics-Juba University describe to me that this is what they do during practical session; ''...we demonstrate to students what they are supposed to do during the practical... after demonstration we leave them to do the experiment...we only guide them in the process of carrying out the experiments...'' (Interview with head of Physics department, a lecturer and a lab technician, Juba University, Jan 2013)

Although there is some element of demonstration at University level, there is a lot of resentment (see table 4.8 in chapter four) on this method at both levels by stakeholders. The reason being it is not meeting public expectations. 11 students from the University said "...we cannot apply what we learned in our practical class outside school life..." Similarly, Africa Education Trust expresses dissatisfaction on the current method of teaching and learning. It laments that;

> Teachers give knowledge to students just like bank and there is no relationship between what is taught and what is happening outside a classroom. The teacher does not relate exactly what he teaches in the classroom to what is happening outside and this is our biggest problem here because students say this is what is taught in the classroom but does not know that it has a very close relationship to what is happening outside. So the method of teaching is not appropriate. (Interview with AET, Jan, 2013)

The question of relationship between what is taught in the classroom to everyday life phenomenon deserves special attention now. Being curious about, I asked the head of department of physics weather he relate everyday phenomenon to teaching and learning in physics. He said;

> I relate teaching to the real life phenomenon. For example, when I am teaching electrostatic I relate it to Africa tradition. In Africa tradition, when it is coming to rain they tell children to prick a spear through the roof of the house. African believes that the spear will conduct the charges to the earth which is true with the current sciences of electrostatics. (Interview with the head of department of physics-University of Juba, Jan 2013).

Even though the relationship between everyday life and teaching is expressed by the teacher above, it is always theoretical. The theory is not always practically translated to practical. It is the ''translational deficit'' that deprives our students of acquiring practical skills. My finding for this study therefore is that teaching is theoretical.

5.4 Relevance of ''learning essentials'' that translate theory to practices

In this sub-section, I essentially discussed findings on the curriculum, contents and tools and laboratory facilities only in relation to practical physics. Their details are beyond the scope of this study and they are intentionally left out. Throughout this thesis a great deal of literature positioned curriculum at the "epicenter" of practical education. We have also seen in the results section what the respondents say about the current state of curriculum, content and laboratory facilities. Basing on the findings, I discussed the relevance of the ''learning essentials'' that translate theory to practices qualitatively, starting with curriculum as follows.

5.4.1 Practical and its place in school Curriculum.

The findings revealed that the South Sudan Secondary School Curriculum (SSSC, 2007) is practical and relevance to the skill needs. Although only one respondent in table 4.12 reported that the South Sudan Secondary School Curriculum strikes good balance between theory and practicals, there are evidences in the (SSSC, 2007)[12] to support the respondent's view. The curriculum outlines sequence of courses to be taught in particular semesters, lists practical tools to be used and the methods of delivery of the practical content. This confirms the view of the AET. However the results on the same table revealed that the curriculum faces numerous challenges such as lack of qualified and practical science teachers, lack of text books for implementing it and the persistence of theoretical Sudan curriculum. This confirmed to the findings of the study conducted by Nivalainen et al. (2010) that practical work in physics is challenged by the limitations of the laboratory facilities and teachers' insufficient knowledge of physics. Ranade (2008) also found that even if science curricula are well-designed, due to lack of laboratory equipment, science teachers have to depend on lecture methods in their teaching. This is the real issues in South Sudan.

Turning on to the University curriculum, the result revealed that the curriculum is not practical. In table 4.14, 26 participants reported that the curriculum is not practical. However, there was mixed filling about this subject. 19 students in table 4.13 view the curriculum as matching to the international standards (see table 4.12). They argued that the curriculum enables learners to pursue master's degree even outside south Sudan. On this, I agree with them but the same students had earlier mentioned in table 4.4 that the practical they do enable them only to achieve classroom objectives not the purpose of practical physics they mentioned in table 4.2. Their arguments are right from academic point of view where the aim of education is simply to go higher and higher and ''stoke'' qualifications. Even though curriculum is not solely responsible for this failure, it is a major theoretical contradiction in education system. What students need to know is that it is not about going for masters but it is about imparting skills that make them function as responsible citizen.

[12] South Sudan Curriculum 2011 was developed after comprehensive peace agreement (2005)

5.4.2 Content

Through documentary analysis (SSSC, 2007) the study revealed that the content prescribed for learners in secondary school level have been accompanied by list of items required for secondary school physics (Senior one to four). Due to absence of skilled teachers and lack of equipments, it was spelled out in the curriculum that there will be no examination on physics but some of the questions will be set to test candidate's evidence of such experiences. It can be concluded that the content is very rich in practical but being implemented theoretically due to lack of practical physics teachers and laboratory equipments.

5.4.3 Laboratory facility and innovation windows

The study generally established that there was lack of school laboratories and laboratory equipments in secondary schools in South Sudan. In table 4.13, 34 respondents said there were no laboratories in secondary schools. However, there were two views in the secondary school I visited. All the 5 students I interacted with reported that the school has no laboratory and therefore no equipment. Contrary to the students' view, 2 officials from the department of secondary education in the MoGE&I reported that the department had provided laboratory equipment to the school. Two questions need particular attention. Where are the laboratory equipment if the ministry has provided and why are they not in use? A Secondary school teacher provided me with an explanation that this equipment were kept in store since the school has no laboratory. This provision is true because I did not observe any science laboratory in the schools. In addition, the school by the time was following Sudan School curriculum which does not permit teaching of practical nor examine it. So there was no need to teach practicals to the students or expose the laboratory equipment to them. Basing on my observation and the views of the respondents, it is hard to talk about relevance of school laboratory and its tools but rather talk about lack of it.

At University level new equipments were observed at the department of Physics, Juba University. These equipments are provided through collaborative effort of Juba University with Oslo University. I also observed a new laboratory which I was told was donated by one of the petroleum companies and it was commissioned for use in 2012. My observation is that the presence of these laboratory facility provided by the Oslo University seems not to be solving the problem of Physics students. First they are not being used because the technicians and the lecturers are not oriented on how to use them and secondly they are few in number. This was attested fact by students and lecturers themselves through interview. Overall, the university resorts to using the observed old equipment. Through observation the equipment provided by the Oslo University are standard and modern laboratory equipment. They are the same equipments used in other Universities around the world. So they are relevance but they are few in number.

5.4.4 Teachers and qualification

All the methods used for data collection revealed that many of the teachers are not trained practical science teachers. In table 4.11, 35 respondents said there was lack of practical skills among teachers. A demographic statistical evident on teacher's qualification through documentary analysis revealed that;

> 2,723 teachers are working in secondary schools in South Sudan, 1,541 (56.6%) teachers are trained, 518 (19%) teachers are untrained, 664 (24.4%) teachers are unknown, 141 (5.2%) teachers in secondary schools have a primary school certificate, 990 (36.4%) teachers in secondary schools have a secondary school certificate, (GESAP, 2012-2017. p. 2)

The presence of 141 teachers in secondary schools with a primary school certificate indicates lack of teachers in secondary schools. Given the fact that there are fewer teachers (SSDP, 2011-2013; GESAP, 2012-2017) the presence of such teachers are very much important at the moment for some learning to take place even if it mean without practicals. Even though the number of science teachers is not disclosed, from experience, a small fraction of teachers would be science teachers with heightened practical science malfunction. A study conducted by Halai (2008) in Pakistan revealed similar finding that there is a significant shortage of science teachers in most developed province of Pakistan; and the situation is much worse in rural areas (Shaila, 2011). She also mentioned that there were teachers who never studied science in school, yet teach science subjects because of the shortage of science teachers. Just like Halai, Omari cited in (Shaila, 2011), expressed similar view that there is a lack of science teachers even in some highly developed countries, such as Canada, USA, the UK, and Sweden. David & Jane (1996) revealed the same finding in Arizona. According to them, only 15% Physics teachers felt qualified to discuss recent developments in physics. The end result is that they teach practical science as though they are teaching history. This confirmed Okello's remark on theoretical contradiction in Uganda's system of Education. His observation of teaching practices by teachers in Uganda made him to make this touching remark about them;

> They tell the students as they listen to theories, they may show them picture of machines and gesture to them but they do not give them practical. Therefore, the students they train do not stand on their own and become manufacturer using their technical skills...they teach them about engineering but do not teach them engineering....they teach them about practical but do not teach them practical. Sic., Okello, (2012, p. 16)

I have so far discussed the importance of practical physics and the relevance of "learning essentials" that translate theory to practice. I now turn to discuss array of problems that were found to be obstacles to unifying thinking theory and practice and in teaching practical physics.

5.5 Hindrances to the progress and realization purposes of practicals

In this sub-section, I explore those factors which are really bottle necks to the progress of practicals. I have earlier noted from the previous discussion that teaching and learning practical physics has taken a trend embedded solely on theoretical physics. Hence the right to relate intellectual capacity (Thinking and Theory) and real world practice (Practical) is considerably ''violated''. The result however did not agree that the aim was to do so. Instead several factors have catalyzed the theoretical practices to be the dominant ones. Some of these challenges have been identifies and discussed within the text under each objective. In this sub-section, I isolate a few and discuss them for clarity.

The study established lack of practical skills among secondary school physics teachers and university lecturers as a challenge to the progress and realization of the purpose of practical physics. In table 4.11, 35 respondents said there was lack of practical skills among teachers. A demographic statistical evident on teacher's qualification through documentary analysis established that there were 141 teachers in secondary schools with a primary school certificate (GESAP, 2012-2017). This clearly indicates lack of teachers in secondary schools. Given the fact that there are fewer teachers, the presence of such teachers are very much important at the moment for some learning to take place even if it mean without practicals. Although the number of physics teachers was not disclosed, from experience, a small fraction of teachers would be science teachers with acute practical science malfunction. A study conducted by Halai (2008) in Pakistan revealed similar finding that there is a significant shortage of science teachers in the most developed province of Pakistan; and the situation is much worse in rural areas (Shaila, 2011). The study further exposed that there were teachers who never studied science in school and yet teach science subjects because of the shortage of science teachers. Just like Halai, Omari cited in (Shaila, 2011), expressed similar view that there is a lack of science teachers even in some highly developed countries, such as Canada, USA, the UK, and Sweden. (David & Jane, 1996) revealed the same finding in Arizona. According to the finding of David & Jane (1996) only 15% of Physics teachers felt qualified to discuss recent developments in Physics.

Lack of school laboratories and laboratory equipments in secondary schools in South Sudan was also generally found to be one of the challenges. In table 4.13, 34 respondents said there were no laboratories in secondary schools. However, there were two views in the secondary school I visited. All the 5 students I interacted with reported that the school has no laboratory and therefore no equipment. Contrary to the students' view, 2 officials from the department of secondary education in the MoGE&I reported that the department had provided laboratory equipment to the school. These controversies raised two questions for particular attention. Where are the laboratory equipment if the ministry has provided and why are they not in use? A secondary school teacher provided me with a plausible explanation that these equipments were kept in store since the school has no laboratory. This conceivable justification is true because I did not observe any science laboratory in the schools. In addition, the school by the time was following Sudan School curriculum which does not permit teaching of practicals nor examining it. So there was no need to teach practicals to the students or expose the laboratory equipment to them. Basing on my observation and the views of my respondents, it is hard to talk about relevance of school laboratory and its tools in secondary schools but rather talk about lack of it.

In secondary schools, the study did not show curriculum as a major problem to practical learning (see table 4.14 and SSSSC, 2007). However, the results on the same table put forth that the curriculum faces numerous challenges such as lack of qualified practical science teachers, lack of text books for implementing it and the persistence of theoretical Sudan curriculum. This reinforced the findings of the study conducted by Nivalainen et al., (2010) that practical work in Physics is challenged by the limitations of the laboratory facilities and teachers' insufficient knowledge of Physics. (Ranade, 2008) also found that even if science curricula are well-designed, due to lack of laboratory equipments, science teachers have to depend on lecture methods in their teaching. This is the real issues in South Sudan.

However, the theoretical nature of the University curriculum was established as another challenge to the progress of practical physics education. In table 4.14, 26 participants reported that the curriculum is not practical. However, there was mixed filling about this subject. 19 students in table 4.4 said the practical they do enable them only to achieve classroom objectives not the purpose of practical physics mentioned in table 4.2. Their arguments are right from academic point of view where the aim of education is simply to higher and higher and ''stoke'' qualifications. Despite curriculum is not solely responsible for this failure, it is a major theoretical contradiction in education system. What students need to know is that it is not about going for masters but it is about imparting skills that make them function as responsible citizen.

The study also made known that lack of fund is one of the factors affecting the progress of practical science education in secondary schools and University. In table 4.4, 9 mentioned lack of fund as a hindering factor. For example fund allocated to the MoGE&I has been between 6% to 7% of the total national budget, (GESAP, 2012/2017). According to my experience this always goes for salaries and block grand. Further, practical education has not attracted donor funding. For example, there are only two development partners (AET and SSEMACESS) supporting practical education in South Sudan. From my experiences, the MoGE&I and donor were directing funds to promote access to children who had no access to education during the 21 years of civil war. Hence emphasis was put on literacy and numeracy than practical education. A similar situation was also established at University level. In table 4.10, 3 lecturers said the department of physics has no fund to purchase necessity laboratory for learners to be able to practice on their own in the lab.

The study also established lack of motivation for creativity. In University of Juba all the students said they only carry out practical on the already listed experiments for a particular semester. In table 4.10 students reported that the University laboratory rules do not allow them to stay in the lab and carry out practical on their own. This suppresses intellectual creativity and creative art of the brain. The students therefore do not have the ability to think since they are either thought theoretically like in secondary schools or the practicals are simply imposed on them. This is not in agreement with the conceptual framework that advocates for harmonization of the creative arts of the brain, theory and practice. Cited in Shaila (2011), Millar and Abraham state that although students like practical work, they often do not learn from a practical the task they are expected to learn, and after a few weeks of carrying out a practical task, most students recall only specific surface details of the task and many are unable to say what they learned from it. Similarly, (Hodson, 1996; Nakhleh et al., 2002; Wellington, 2000) and Halai (2008) cited in (Shaila, 2011) states that practical work is not helpful enough in achieving the goals of practical science education. They proposed other learning processes such as project learning, group discussion and learners motivation to design their own experiment. To them, these would develop learners' creative arts of the brain which is very important in learning as suggested in the conception framework for this study.

5.6 Ways of making practical physics meet its purposes and stakeholders expectations

In table 7, through interviews and group discussion my respondents voiced their opinions which they hope would help in the realization of the purposes of practical physics. They proposed training of teacher and lecturers on skills of practical physics, giving practical immediately after theory. This proposal is in agreement with the view documented in GESAP, 2012-2017) that to build a high quality education system, the MoEG&I need to have a qualified teaching workforce that teaches relevant and inclusive curricula to learners, using high quality learning and support materials. This calls for professionalization of teachers towards methodology that is aligned to practical skills. Therefore priority should be given to teacher education as Uwaifo cited in Uwaifo (2009) argues that education unlocks the door for modernization but it is the teacher who holds the key to the door. In my analysis, this statement indicates that teachers are axial on which any successful educational programme revolves. It is the teachers who help students make connections with the real world.

The respondents also proposed provision of laboratory tools and facilities to secondary schools and University as one of the ways of promoting practical physics education in the country. 33 participants in table 4.5 thought that if practical tools are provided in secondary school, learners will be able to use those tools to practice and acquire skills which they will use in their daily life.

Participants also proposed development of skill based curriculum that promotes teaching of practical subjects and providing more fund for practical physics. This is in line with Okello (2011)'s nexus that there is need to revised the existing curriculum to reflect the desired skill and technical needs of the youths and the public.

Participants also thought that practical learning can be promoted through technical and vocational schools (see table 4.6). This proposal falls within the demand of South Sudanese youths whose views are presented below;

> "...we need more vocational schools so that we can learn something that we can do with our own hands[13]...in my school there are no teachers...no books...we are many...even the teachers who come, don't come regularly because many are discouraged by low salaries... sometimes they don't get paid on time... we can see that teachers are not very encouraged to teach us but what can we do...there are no jobs...we need to help ourselves..."- young girl doing electrical training in a local vocational school (GEASP, 2012/2017, p. 20)

[13] There is no baseline data available to calculate the transition from either secondary or tertiary levels of education into employment. The MoGEI and MoHEST will work with the Ministry of Labour, Youth and Sports and the International Labour Organisation (ILO) during the period of the STRATEGIC PLAN to establish a baseline data in order to calculate external efficiency in the future.

It was established another way of promoting the progress and to realize of the purpose of practical physics is to create awareness about the practical physics. 20 participants in table 4.6 believe that practical would increase the quality and scope of practical physics. This view is true but this study identified stronger challenges that need to be dealt with first. However awareness is important for those in a position of making decision such as officials in the MoGE&I. This will enable them to develop policy that promote the progress of practical education in the country

5.7 Summary of the discussion

I have discussed extensively, mixing the views of practical physics educators to explain why ''practical physics now'' and its purpose and application in everyday life and in bringing about societal transformation in a forth right manner. Ripple effects of the relevance of the practical ''learning essentials'' were also discussed. The details of the curriculum do not form the scope of this thesis and were intentionally left out. Reference were made to the various parts of the text to ensure no lost of truck.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

In this chapter, I present concise statements of account of major findings, conclusions for each research question and suggest recommendations seeking improvement and creating practical avenues for practical physics in particular.

6.2 Summary

The purpose of the study was to examine the teaching strategies used by physics teachers for design practical questions so as to enable students see connection between what they learn in physics and use them in their daily life. Three objectives were set; to establish the importance of experimental physics, to examine how teachers prepare learners for designed practical physics for use in their daily life and to establish the relevance of ''learning essentials'' that translate theory to practice in everyday students' life using descriptive research design following qualitative research method. The methods used for data collection were interview, focus group discussion and documentary analysis.

The result showed that there is a marked awareness amongst the students, teachers, government officials and development partners about the importance of practical physics and its application in everyday life and in bringing about societal transformation in a forth right manner.

Despite such recognition, the study found out that teaching and learning practical physics has taken a trend embedded solely on theoretical physics. Hence, the right to relate intellectual capacity (Thinking and Theory) and real world practice (Practical) among students is considerably ''violated''. The results however did not agree that the aim was to do so. Instead several factors have catalyzed the theoretical practices to be the dominant ones. These include lack of laboratory facilities in secondary schools, lack of trained practical teachers, inappropriate teaching methodologies both in secondary schools and university.

The study also found out that the existing curriculum is theoretical and therefore practical exams are not being considered for secondary schools. Almost all secondary schools in South Sudan have no Laboratory. A few national secondary schools that have received the first lots of distributed laboratory equipments are not even using them.

The conceptual framework and the explanation provided in the background agree well with the views of stakeholders on how practical physics should be taught and the quality of the support learning materials. Therefore, the conceptual model may be used by teacher educators and practical teachers.

Paragraph two and three of this summary confirm to general statement made in the background of the study (see paragraph one and six). However the statement made in the background about students failing practical exam was over generalization. UNEB exams were only administered to schools along the equatorial belt bordering Uganda. Although over generalization, the first practical agriculture examination administered in 2012 is still a supportive evident that students do not do well in Practical exams. These findings led me to make these conclusions.

6.3 Conclusions

Stakeholders (youths, students, teachers, government officials and development partners such as AET and SSEMACESS) are very much aware of the importance of practical physics and its application in everyday life and in bringing about societal transformation in a forth right manner. Aware as they are, there are not enough evidents that show that there is improvement in practical learning in secondary schools and the university. For example the ministry of general education and instruction does not have science policy and budget line for it.

Teaching of practical sciences in general and physics in particular has taken up a methodology deeply rooted in theoretical dimension. There is immense lack of practical physic teachers coupled with lack of practical equipment in both the university and secondary schools. As such the current teaching and learning methodologies do not enable the learners, institutions and the country to achieve the purpose of practical physics education.

South Sudan secondary school curriculum is rich in practical content but existence of Sudan curriculum has hindered its implementation. Although the curriculum is rich in practical as stated, some of the desired equipment are not provided for its implementation. For example in modern physics one of the laboratory facility stated in the curriculum is cathode rays oscilloscopes which are not provided to schools.

6.4 Recommendations

The summary and the conclusions are touching facts but South Sudan being a new country has not lost truck yet. The country only has two years into independence. Such challenges are highly expected in the system. I therefore recommend the following which I believe will impact more positively if consideration is done to them. I have drawn these recommendations from the findings that I have obtained from the fields provided by education stakeholders in the country.

6.4.1 Practical physics, its importance

Awareness: I recommend the Ministry of General Education and Instruction to join hands with the Ministry of Higher Education and Research to peak up the level of awareness of practical education among the education stakeholders. The national ministries in partnership with the development partners need to stage a practical science campaign at national, state and county levels. This also needs to proceed to the nucleus of educational activities, the schools. Launching a national campaign is a commitment that they undertake.

Increase funding: to fund science projects, the current funding which has been oscillating, on average, between 6% to 7% of the country's Gross Domestic Product (GDP) needs to be increased from the national budgets (GESAP, 2012/2017).

Policy issues: There is also need to come up with open science policy to convince development partners and donors to start supporting practical science education in the country. Currently there are very few development partners (AET and SSEMACESS) supporting practical science education in the country.

6.4.2 How teacher prepare learners for practical Physics

Teachers: I recommend that the teacher must encourage learners' interests by helping them to see how and what their learning in schools prepares them for life in the real world. They should endevour to nature the potential every learner has to the fullest and move away from teaching practicals that test and verify facts to teaching experiments that can be applied in learner's daily life. Teachers, if we teach today as we taught yesterday we rob our children of tomorrow.

Teacher education and training: teacher education for science teachers should become a number one priority for South Sudan. There is need to train them in practical skills as the world is taking trend rooted deeply on technology. Teacher trainers should include a larger portion of practical in their training or hands-on learning. The teacher training should take on pedagogy rooted in practical learning and should aim at training the teacher with practical skills just as technicians.

Learners: I recommend that each time learners should try something different, something practical and something innovative. Their interests must be maintained by helping them see how and what their learning prepares them for life in the real world. Teachers must excite learners to become more resourceful so that they will continue to learn outside the formal school schedule.

School: I recommend that the school spends some time outside the confine of the classrooms. It should lead its learners through the bridge connecting the teachers, students and the community with working life and the wealth of knowledge that exists in the world. The school should create a community of practice.

6.4.3 "Learning essentials"

Curriculum: The ministry need to review the existing curriculum to reflect the equipment and methodologies that teacher should use while teaching particular subjects like physics. The curriculum objectives need to be modified in a way that it is skill-based and that it addresses the real societal problems rather than being academic.

Laboratory equipments: to support the implementation of her newly designed curriculum, the ministry need to procure practical equipment and review a national distribution system that ensure that all the schools receive these equipments rather that limiting it to a few national secondary schools. Alternatively state ministries should be provided with fund to buy practical equipments for the schools under them. It is praiseworthy that the equipments specified for implementing the curriculum are provided accordingly.

Introduce vocational workshop: alongside our academic laboratory schools should endeavor to open up a vocational section in secondary schools. This will provide learners with creative skills as they learn and practice in the workshop.

Further studies: I recommend further study to be taken on the same topic but this time it should focus on teacher education with the aim of finding out how science teachers are being prepared in their training colleges. Their training also matters a lot in teaching and learning practical physics.

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Appendixes

Appendix 1: Data collection Instrument

Appendix 1.1: Interview and focus group discussion guide for Teachers/Lecturers

Demographic information

Sex : ☐ male ☐ female

Age: ☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 45-50

Occupation year ....

Years of experience: ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ 31-35

Qualification: ☐ MSc. In Physics ☐ Degree in Physics ☐ Diploma in Physics ☐ Others

Experimental Physics, its importance

This objective emanates from the fact that first and foremost there is need to have a greater reconceptualization of what practical physics is there for by teachers, learners, development partners and government officials in the MoGE&I. For this reason the following questions were prepared.

1. What is meant by practical work in physics education?
2. What are the aims and purposes of practical in physics education?
3. What do you make of the current teaching and facilities toward greater realization of the purpose of practical physics?
4. In your opinion what are the factors that facilitate good quality practical work and the barriers that hinder its progress?
5. What are the opportunities for developing and extending practical work in science in South Sudan?
6. What are the key issues that need to be addressed in order to improve the quality and the scope of practical work in physics in schools?
7. How can physics be made applicable to solving real world problems in student life outside school?

How teachers prepare Learners for Design Practical Questions

This objective is formulated from the fact that education is a key for national development but it is the teacher who hold the key (Owaifo, 2005), therefore any nation that who wants to transform from knowledge to technology-based society must turn to the teacher. The following questions have been prepared to find out how teachers prepared learners for practical physics and the challenged they face.

1. Form your experience as physics teachers describe briefly how you prepare learners for practical questions in physics?
    i. Are these practices appropriate for giving the learners the skills what learners will use in their daily life outside schools?
    ii. Please explain your opinions
2. In your opinion as a teacher what methods do you consider appropriate for teaching designed practical physics so that it is related to the everyday life phenomenon and applicable in society?

3. Do you as a physics teacher allow learners to design their own experiments to produce modified version similar to the standard experiment?
    i. If yes or no provide explanation
4. Do integrate everyday life phenomenon in teaching practical physics.
    i. If you do please explain why this is important
    ii. Please explain how you do it.
5. What challenges do you face organization (s) in promoting practical physics?
6. How may these challenges be minimized?

Relevance of Learning Essentials that Translate Theory to Practice

Curriculum is a tool that gives education the legitimacy it deserves. Practical and applicable curriculum is anchored on practical curriculum that gives applicable skills to the learners; skills that they will use is solving real world problem in their daily life. For this reason the following questions were prepared to find out the state of affairs of the curriculum.

1. Discuss the strength and weakness of the following in promoting physics practical
   (A)Curriculum
   (b)Practical facilities
   (c)teachers
2. In your view how relevance south Sudan curriculum in promoting practical physics/learning?
   What reason would you provide for this?
3. What challenges is facing South Sudan Curriculum
4. In your own view what changes do you recommend to improve it practicality?

Appendix 1.2: Interview and Focus group discussion guide for Students

Demographic information

Sex : ☐ male ☐ female

Age: ☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 45-50

Occupation year ....

Years of experience: ☐1-5 ☐6-10 ☐11-15 ☐16-20 ☐ 21-25 ☐26-30 ☐ 31-35

Qualification: ☐ MSc. In Physics ☐Degree in Physics ☐ Diploma in Physics

☐ Others

Experimental Physics, its importance

This objective emanates from the fact that first and foremost there is need to have a greater reconceptualization of what practical physics is there for by teachers, learners, development partners and government officials in the MoGE&I. For this reason the following questions were prepared.

1. What is meant by practical work in physics education?
2. What are the aims and purposes of practical in physics education?
3. What do you make of the current teaching and facilities toward greater realization of the purpose of practical physics?
4. In your opinion what are the factors that facilitate good quality practical work and the barriers that hinder its progress?
5. What are the opportunities for developing and extending practical work in science in South Sudan?
6. What are the key issues that need to be addressed in order to improve the quality and the scope of practical work in physics in schools?
7. How can physics be made applicable to solving real world problems in student life outside school?
8. What has the government done so far to improve the teaching to practicals to transform the society to technological society?

How teachers prepare Learners for Design Practical Questions

This objective is formulated from the fact that education is a key for national development but it is the teacher who hold the key (Owaifo, 2005), therefore any nation that who wants to transform from knowledge to technology-based society must turn to the teacher. The following questions have been prepared to find out how teachers prepared learners for practical physics and the challenged they face.

1. From your experiences as a science/physics student explain briefly how teachers prepare you for practical questions in physics?
   i. Are these currents teaching and learning strategies appropriate for giving the learners the skills that you will use in your daily life outside schools?
   ii. Please explain your opinions
2. In your opinion, what methodology would you wish to see your teachers apply in teaching designed practical physics so that it is related to the your everyday life phenomenon and applicable in society?

3. Does your teachers to allow you to design your own experiments or to produce modified version similar to the standard experiment?
    i. If yes or no please explain why.
4. Do your teachers to integrate everyday life phenomenon in teaching practical physics.
    i. If they do please explain why this is important
    ii. If they do not explain why they don't.
5. What are what mechanisms are in place to promote practical science education in South Sudan Secondary schools and university?
6. What challenges do you face as student(s) in learning practical physics?
7. How may these challenges be minimized

Relevance of Learning Essentials that Translate Theory to Practice

Curriculum is a tool that gives education the legitimacy it deserves. Practical and applicable curriculum is anchored on practical curriculum that gives applicable skills to the learners; skills that they will use is solving real world problem in their daily life. For this reason the following questions were prepared to find out the state of affairs of the curriculum.

1. Discuss the strength and weakness of the following in promoting physics practical
   (A)Curriculum
   (b)Practical facilities
   (c) teachers
2. In your view how relevance south Sudan curriculum in promoting practical physics/learning?
   What reason would you provide for this?
3. In your own view what changes do you recommend to improve it practicality?

Appendix 1.3: Interview and focus group discussion guide for Government Officials in MoGE&I

Demographic information

Sex : ☐ male ☐ female

Age: ☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 45-50

Occupation year ....

Years of experience: ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ 31-35

Qualification: ☐ MSc. In Physics ☐ Degree in Physics ☐ Diploma in Physics
☐ Others

Experimental Physics, its importance

This objective emanates from the fact that first and fore most there is need to have a greater reconceptualization of what practical physics is there for by teachers, learners, development partners and government officials in the MoGE&I. For this reason the following questions were prepared.

1. What is meant by practical work in physics education?
2. What are the aims and purposes of practical in physics education?
3. What do you make of the current teaching and facilities toward greater realization of the purpose of practical physics?
4. In your opinion what are the factors that facilitate good quality practical work and the barriers that hinder its progress?
5. What are the opportunities for developing and extending practical work in science in South Sudan?
6. What are the key issues that need to be addressed in order to improve the quality and the scope of practical work in physics in schools?
7. How can physics be made applicable to solving real world problems in student life outside school?
8. What has the government done so far to improve the teaching to practicals to transform the society to technological society?

How teachers prepare Learners for Design Practical Questions

This objective is formulated from the fact that education is a key for national development but it is the teacher who hold the key (Owaifo, 2005), therefore any nation that who wants to transform from knowledge to technology-based society must turn to the teacher. The following questions have been prepared to find out how teachers prepared learners for practical physics and the challenged they face.

1. Form your observation as teacher educator, education authority and examiners, explain briefly how teachers prepare learners for practical questions in physics?
   i. Are these practices appropriate for giving the learners the skills what learners will use in their daily life outside schools?
   ii. Please explain your opinions
2. In your opinion, what methodology would your organization/MoGE&I wish to see teachers sue in teaching designed practical physics so that it is related to the everyday life phenomenon and applicable in society?

3. Does your organization encourage teachers to allow learners to design their own experiments to produce modified version similar to the standard experiment?
   i. If yes or no provide explanation
4. Does your principle encourage teachers to integrate everyday life phenomenon in teaching practical physics.
   i. If you do please explain why this is important
5. What are what mechanisms are in place to promote practical science education in South Sudan Secondary schools and university?
6. What challenges do you face as institution in promoting practical physics?
7. How may these challenges be minimized

Relevance of Learning Essentials that Translate Theory to Practice

Curriculum is a tool that gives education the legitimacy it deserves. Practical and applicable curriculum is anchored on practical curriculum that gives applicable skills to the learners; skills that they will use is solving real world problem in their daily life. For this reason the following questions were prepared to find out the state of affairs of the curriculum.

1. Discuss the strength and weakness of the following in promoting physics practical
   (A)Curriculum
   (b)Practical facilities
   (c)teachers
2. In your view how relevance south Sudan curriculum in promoting practical physics/learning?
   What reason would you provide for this?
3. What are some of the challenges facing South Sudan curriculum?
4. In your own view what changes do you recommend to improve it practicality?

Appendix 1.4: Interview and focus group discussion guide for Development Partners.

Demographic information

Sex : ☐ male ☐ female

Age: ☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45 ☐ 45-50

Occupation year ....

Years of experience: ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-25 ☐ 26-30 ☐ 31-35

Qualification: ☐ MSc. In Physics ☐ Degree in Physics ☐ Diploma in Physics

☐ Others

Experimental Physics, its importance

This objective emanates from the fact that first and foremost there is need to have a greater reconceptualization of what practical physics is there for by teachers, learners, development partners and government officials in the MoGE&I. For this reason the following questions were prepared.

1. What is meant by practical work in physics education?
2. What are the aims and purposes of practical in physics education?
3. What do you make of the current teaching and facilities toward greater realization of the purpose of practical physics?
4. In your opinion what are the factors that facilitate good quality practical work and the barriers that hinder its progress?
5. What are the opportunities for developing and extending practical work in science in South Sudan?
6. What are the key issues that need to be addressed in order to improve the quality and the scope of practical work in physics in schools?
7. How can physics be made applicable to solving real world problems in student life outside school?
8. What has the government done so far to improve the teaching to practicals to transform the society to technological society?

How teachers prepare Learners for Design Practical Questions

This objective is formulated from the fact that education is a key for national development but it is the teacher who hold the key (Owaifo, 2005), therefore any nation that who wants to transform from knowledge to technology-based society must turn to the teacher. The following questions have been prepared to find out how teachers prepared learners for practical physics and the challenged they face.

1. Form your observation as teacher educator and practical science promoters explain briefly how teachers prepare learners for practical questions in physics?
   i. Are these practices appropriate for giving the learners the skills what learners will use in their daily life outside schools?
   ii. Please explain your opinions
2. In your opinion, what methodology would your organization/MoGE&I wish to see teachers sue in teaching designed practical physics so that it is related to the everyday life phenomenon and applicable in society?
3. Does your organization encourage teachers to allow learners to design their own experiments to produce modified version similar to the standard experiment?

i. If yes or no provide explanation

4. Does your principle encourage teachers to integrate everyday life phenomenon in teaching practical physics.
    i. If you do please explain why this is important
5. What are what mechanisms are in place to promote practical science education in South Sudan Secondary schools and university?
6. What challenges do you face organization (s) in promoting practical physics?
7. How may these challenges be minimized

Relevance of Learning Essentials that Translate Theory to Practice

Curriculum is a tool that gives education the legitimacy it deserves. Practical and applicable curriculum is anchored on practical curriculum that gives applicable skills to the learners; skills that they will use is solving real world problem in their daily life. For this reason the following questions were prepared to find out the state of affairs of the curriculum.

1. Discuss the strength and weakness of the following in promoting physics practical
   (A)Curriculum
   (b)Practical facilities
   (c)teachers
2. In your view how relevance south Sudan curriculum in promoting practical physics/learning?
   What reason would you provide for this?.
3. In your own view what changes do you recommend to improve it practicality?

Appendix 2: Introductory Letter

KYAMBOGO UNIVERSITY

P. O. Box 1 Kyambogo, Phone: 041-285001/2 Fax: 041-220464, Kampala
www.kyambogo.ac.ug

FACULTY OF VOCATIONAL STUDIES

DEPARTMENT OF ART & INDUSTRIAL DESIGN

Date: 5th January, 2013

To: Ministry of General Education and Instruction, Juba University, Africa Education Trust, Strengthening Science and Mathematics Education in South Sudan and Juba Day Secondary School

RE: LETTER OF INTRUDUCTION

This is to introduce Mr/Ms/Mrs. ACHIRE TITO
Registration No 2011/X/HD/396/MVP who is a student of Kyambogo University pursing on a post graduate programme in Vocational Pedagogy.

He/She intends to carry out a research in:

Unifying thinking, Theory and practice in Physics Education in South Sudan

as partial fulfillment of the requirements for the award of the Degree in Masters of Vocational Pedagogy

We therefore kindly request you to grant him/her permission to carry out the research at your organization.
Any assistance accorded to him/her shall be highly appreciated.

Thank you.

Yours Faithfully,

KYAMBOGO UNIVERSITY
09 JAN 2013
DEPARTMENT OF ART AND INDUSTRIAL DESIGN

Mugisha John
Ag. Head of Department
Art and Industrial Design